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Water Plant Optimization Study

PETERBOROUGH WATER TREATMENT PLANT

December 1990

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Water Plant Optimization Study

Peterborough
Water Treatment Plant

Project No. 7-2018

December 1990

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WATER PLANT OPTIMIZATION STUDY
PETERBOROUGH WATER TREATMENT PLANT

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The purpose of the Water Plant Optimization Study (WPOS) is to document and review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on the removal of particulate materials and the disinfection processes.

In striving for excellence in water treatment, it is important to examine all possible approaches, but first, optimum use should be made of the processes already in place.

This optimization study is a beginning and not an end to itself; it is the start of an ongoing documentation of the operation of the plant. It is recommended that this document be updated on an annual basis.

Considerable strides towards optimization of the Peterborough Water Treatment Plant have been made by the Peterborough Utilities Commission operational staff. The Peterborough Utilities Commission is continually expanding its water treatment knowledge, and has an interest in research work. If the Peterborough facilities were determined to be suitable for research into a particular aspect of water treatment, the Commission would be receptive to considering such initiatives.

In an effort to optimize particulate removal and disinfection at the Peterborough Plant, this study suggests the following:

PHYSICAL IMPROVEMENTS

- Install totalizers on each filter to quantify flows.
- Install filter effluent turbidimeters or turbidity monitoring stations to monitor the effluents of the eleven filters.

STUDIES

- Conduct laboratory and/or plant scale testing to evaluate the relative merits of blending and flash mixing.

STUDIES (cont'd)

- Conduct laboratory and plant scale testing to evaluate the optimum coagulant and the merits of coagulant aids.
- Conduct plant scale studies on the effects of flow rate on the flocculation tank performance.
- Conduct plant scale testing to evaluate the effect of lower constant filtration rates on filter effluent quality.
- Conduct a detailed investigation to evaluate the relative performances of the filters.
- Investigate the backwash procedure to evaluate the optimum rise rates and wash water volumes.
- Conduct studies to evaluate the possible methods of THM reduction.

OTHER RECOMMENDATIONS

- Add a coagulant at all times.
- The Ministry of the Environment should develop a surrogate measurement for chlorinated by-products for use in water plants in Ontario.
- Prepare a process and piping diagram (PAPD) for the Peterborough Water Treatment Plant.

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TERMS OF REFERENCE

WATER PLANT OPTIMIZATION STUDY
PETERBOROUGH WATER TREATMENT PLANT

INTRODUCTION AND TERMS OF REFERENCE

The Ontario Ministry of the Environment has instituted a Drinking Water Surveillance Program, consisting of a continuously updated data base of water quality information on Ontario water treatment plants. In connection with the surveillance program, a specific plant investigation and process evaluation study is desired for each plant entering the program. The study is to document and review the present operating conditions, and determine an optimum treatment strategy for particulate removal and disinfection at the plant. The terms of reference for this Water Plant Optimization Study has been prepared by the Ministry, and is included at the back of the report, following the appendices. This study has been conducted in accordance with the terms of reference.

The Peterborough Utilities Commission is responsible for the water supply and distribution system for the City of Peterborough. The Peterborough plant also supplies water to the Woodland Acres Subdivision in Smith Township. This optimization study provides a detailed examination of three years (1984 to 1986) of daily and monthly plant operating data, a description of the facilities in place at the plant and their operation, and recommendations which would improve the particulate removal and disinfection performance of the plant.

The quality of the Peterborough treated water is quite good. Microbiological testing showed no positive results for either total or fecal coliforms for the study period of this report; turbidity levels were generally less than 0.5 FTU, and did not exceed the Ministry of the Environment objective of 1 FTU.

SECTION A

RAW WATER SOURCE

SECTION A
RAW WATER SOURCE

A.1 General Quality

The Peterborough Water Treatment Plant draws water from the Otonabee River. The raw water quality is good.

During the years 1984-1986, the general raw water quality parameters varied as follows:

Colour (TCU)	10 - 30	(1)
Turbidity (FTU)	0.2 - 1.25	(1)
Temperature (°C)	0.3 - 25	(1)
pH	7.4 - 8.3	(1)
Hardness (mg/L as $CaCO_3$)	84 - 100	(2)
Alkalinity (mg/L as $CaCO_3$)	74 - 80	(2)
Aluminum (mg/L)	0.008 - 0.069	(3)
Iron (mg/L)	0.02 - 0.072	(4)
Manganese (mg/L)	0.012 - 0.014	(4)
Fecal Coliform (per 100 mL)	0 - >500	(5)

(1) Values recorded in daily log books at the Peterborough Filtration Plant for the period of January 1984 to December 1986.

(2) Values recorded on Ministry of the Environment Forms (1984) kept at the Peterborough Water Filtration Plant.

(3) Values recorded on lab results sheets from outside laboratories and MOE lab kept at the Peterborough Water Filtration Plant.

(4) Values recorded on monthly MOE lab results kept at the Peterborough Water Filtration Plant.

(5) Values recorded on daily MOH lab result sheets kept at the Peterborough Water Filtration Plant.

A.2 Security

The Peterborough plant is downstream of the village of Lakefield where some commercial and industrial development is located on and about the Otonabee River. Thus, there exists a potential for contaminants, such as metals or sewage waste, to appear in the raw water, but none has been detected to date.

SECTION B

FLOW MEASUREMENT

SECTION B
FLOW MEASUREMENT

B.1 Raw

The raw water is pumped out of the low lift station through two raw water mains; one 914 mm concrete and one 760 mm cast iron. Both feed into one 914 mm raw water main.

The raw water flow is measured by a 914 mm venturi meter located in the basement of the high lift pumping station/filter building. The capacity of the meter is 180 ML/d. A BIF transmitter sends a 15 second time pulse signal to the integrator in the control room. The raw water flow is recorded on a 305 mm diameter chart and totalized continuously in the control room. The totalized flow is recorded every 24 hours on the daily record and totalled for the day.

B.2 Treated

The treated water is routed to either Zone 1 or Zone 2. The Zone 2 electric pumping station is located at the plant; the Zone 1 combination turbine-driven and electric pumping station is located approximately 1 km downstream of the plant. Zone 1 feeds the central, east, and south sections of Peterborough, and Zone 2 feeds the northwest and southwest sections of Peterborough.

Zone 1 flow to the west side of the river is measured by a 508 mm venturi meter and a 406 mm venturi meter. A new 762 mm probe Magnetic meter has been installed on the suction side of Zone 1, which measures the total flow to both the east and west sides of the river. The meter has a maximum capacity of 113.5 ML/d, and a Pribusin transmitter sends a 4-20 mA signal to the integrator in the control room.

Zone 2 flow is measured by a 760 mm venturi meter which has a maximum capacity of 54.5 ML/d. This meter was installed in 1976. A BIF transmitter sends a 15 second time pulse signal to the Zone 2 integrator in the control room.

B.2 Treated (cont'd)

The Zone 1 and 2 flows are recorded on individual charts, and are totalized continuously in the control room. The total treated flow is also recorded continuously on a chart. Each flow is totalled and recorded every 24 hours on the daily record.

B.3 Backwash

There are two backwash pumps which discharge into a 610 mm wash water header. The flow in this header is measured by a 610 mm venturi meter which has a maximum capacity of 90 ML/d. A BIF transmitter sends a 15 second time pulse signal to the control room. Backwashing is normally accomplished by using one of the pumps.

B.4 Filters

There are six original filters, numbered 1-6, in Plant 1. Three additional filters, Filters 7-9, were added to Plant 1 in 1952. Each of the nine filters have separate flow meters; each of these flow meters have a maximum capacity of 6.8 ML/d.

In 1965, two filters were added in Plant 2. Each of these filters has a 350 mm insert venturi nozzle flow meter with a maximum capacity of 29.5 ML/d.

B.5 Validity

If no leakage were to occur, the raw water minus the backwash water would equal the treated water pumped over a 24-hour period, provided there was no net change in the clearwell level. The treated water flow at the Peterborough Water Filtration Plant is calculated on this basis.

The total plant effluent is calculated by subtracting the measured backwash water flow from the measured raw water flow. No discrepancies in the pumping record arise with this method of calculating the flowrates, and therefore, the flow data in Table 1.0 of Appendix A shows a consistent and systematic set of information. The Zone 1 flow is calculated by subtracting the Zone 2 effluent from the calculated plant effluent. The Zone 1 flow meter is used for chemical flow pacing only.

There are no absolute minimum effective capacities for the venturi meters which measure the raw water flow and the treated Zone 2 flow. However, unreliable flow measurements are usually experienced when the flow rate is less than 20% of the meter's capacity. The flow data shown in Table 1.0 of Appendix A indicate that the minimum flows are greater than 20% of the venturi capacities.

The raw and Zone 2 treated water transmitters are calibrated 3 to 4 times per year, or more often if necessary, by Peterborough Utilities Commission staff. The Peterborough Utilities Commission believes these flow measurements are quite accurate. The backwash water flow measurement is also considered to be accurate, and this transmitter is calibrated at least once a year.

The per capita flow data provided in Table 1.1 of Appendix A includes a fairly high average and maximum daily flow. The policy of the Peterborough Utilities Commission to charge single family residential customers and small commercial customers on a variable flat rate basis may influence the relatively high per capita flows.

In the mid to late 1970's, a comprehensive leak detection survey of the entire distribution system was carried out, and only small insignificant leakage in the distribution watermains and public water services was uncovered. Since then, the per capita flows have risen in proportion to the increased development. The relatively high average and maximum per capita flows do not appear to be a result of distribution system leakage.

SECTION C

PROCESS COMPONENTS

SECTION C
PROCESS COMPONENTS

C.1 General

This section includes detailed information on Design Data and the Chemical Systems.

This section also contains a series of photographs to illustrate the major plant components and chemical feed systems.

C.2 Design Data

(a) Plant Capacity

The original plant, consisting of Filters 1-6 in Plant 1, was built in 1922. It includes settling, filters, and appropriate pumping. Since 1922, the plant has undergone expansions in 1952 and 1965. Filters 6-9 were added to Plant 1 in 1952. The construction of mixing chambers preceeding the settling tanks occurred in 1965. Filters 1 and 2 were added to Plant 2 during this expansion.

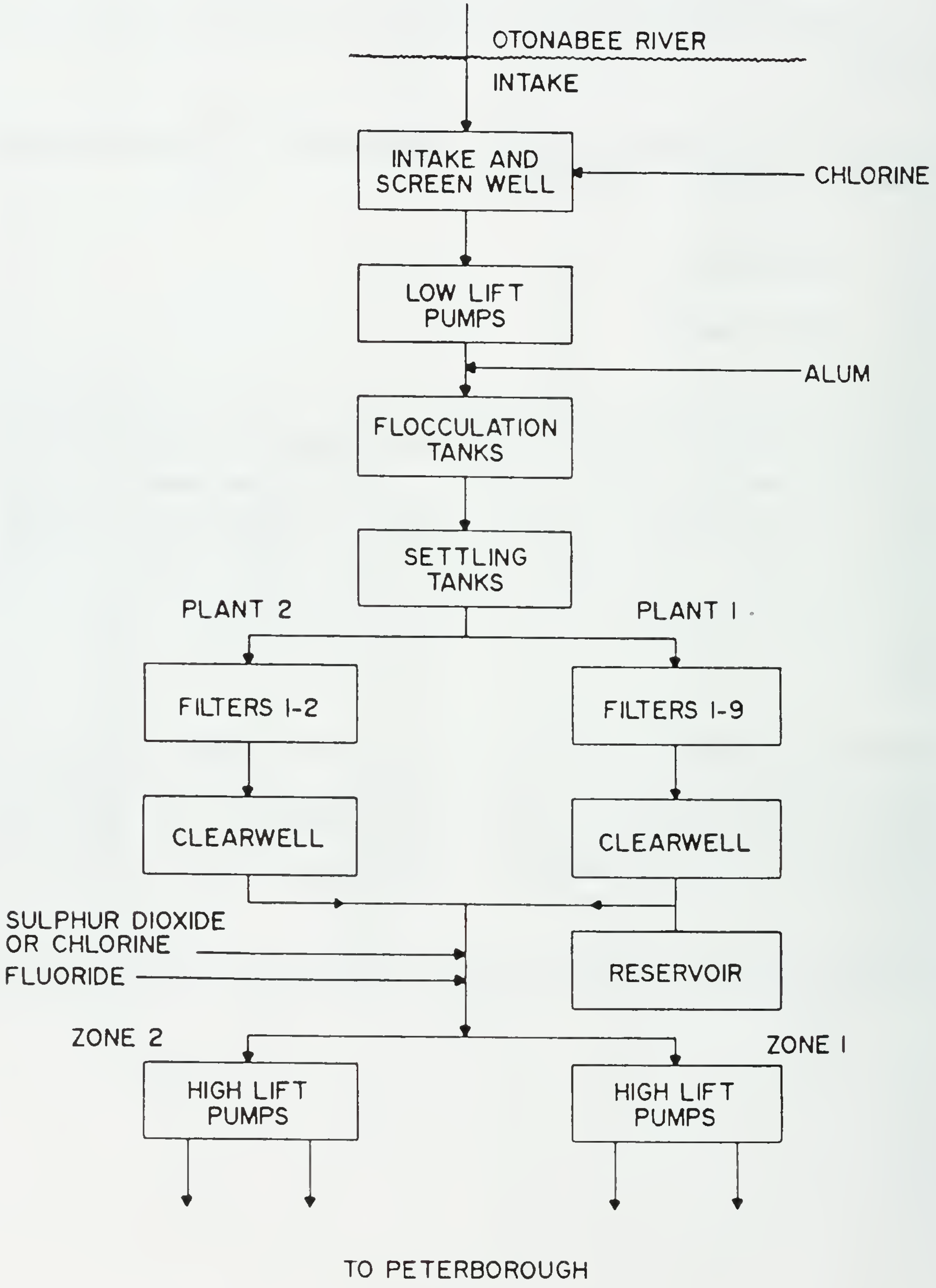
Numerous piping, pumping, and instrumentation changes have occurred over the years.

The capacity (hydraulic) of the facilities is approximately 100 ML/d, with a present average daily flow of about 50 ML/d. All of the operating data presented herein are based on flows of 50 and 100 ML/d. For the purposes of this report, it has been assumed that the raw water flow splits evenly between the two sets of mixing chambers.

The hydraulic design capacities of the filters are shown on the following page:

FIGURE I

PETERBOROUGH WATER TREATMENT PLANT
PROCESS AND PIPING SCHEMATIC



(a) Plant Capacity (cont'd)

	YEAR	DESCRIPTION	ORIGINAL CAPACITY (ML/d)
Original	1922	Filters 1-6	40.8
Expansions	1952	Filters 7-9 Plant 1	20.4
	1965	Filters 1-2 Plant 2	59
TOTAL			120.2

Although the sum of the individual filter hydraulic capacities is 120 ML/d, the nominal capacity (hydraulic) of the plant is limited to approximately 100 ML/d due to hydraulic restrictions before and after the filters.

(b) Intake

Twin intakes — 1922, 22 m long, 760 mm diameter cast iron pipe.

These twin intakes consist of an open end of pipe in a concrete headwell. There is no crib. Each intake has a capacity of approximately 90 ML/d. The submerged depth is about 2 m ± 0.3 m.

(c) Intake Well

The intake pipes terminate with isolation valves in a concrete intake well just before the stationary water screens.

Chlorine is added in the intake well.

(d) Screening

There are six stationary water screens, 1.2 m x 1.2 m. The mesh material is 3 mm diameter galvanized steel wire with 25 mm openings. The screens are cleaned manually as required. The most frequent cleaning, perhaps once a month, occurs in the fall, when the debris consists of leaves. When the river is not covered with ice in the winter, frazile ice problems may occur, and the screens are cleaned as required to prevent this. The frazile ice usually forms during the night, and the screens may require cleaning as often as once every 6 hours.

(e) Low Lift Pumping

There is one low lift suction well, 3.4 m x 3.7 m x 6.7 m deep, and four low lift pumps.

PUMP NO.	YEAR INSTALLED	TYPE	CAPACITY (ML/d)	POWER (kW)	HEAD (m)	MANUFACTURER
1	1950	Electric	13.6	44.7	21.3	Allis & Chalmers
2	1984	Electric	45.4	111.9	18.3	Worthington
3	1966	Elec./Diesel	45.4	111.9	18.9	Allis & Chalmers
4	1976	Electric	63.6	186.4	18.9	Allis & Chalmers
		TOTAL INSTALLED	168			
		FIRM CAPACITY	104			

(f) Flash Mixing

There is no flash mixing at the Peterborough plant.

(g) Flocculation

All flocculation tanks are hydraulic spiral upflow and are made of concrete. Raw water enters the middle cell of the flocculation tanks and flows to either adjacent cell before entering a settling tank.

(g) Flocculation (cont'd)

Flocculation tanks No. 1 feed settling tank Nos. 1 and 2, and flocculation tanks No. 2 feed settling tank Nos. 3 and 4. The total volume of the flocculation tanks is 1045 m^3. Both sets of tanks are identical and consist of three concrete cells, each 5.3 m x 5.3 m x 6.2 m deep. Assuming a 50 percent split of flows between the two sets of tanks, the flocculation detention times at 100 and 50 ML/d are 15 and 30 minutes, respectively.

The mixing velocity gradients in the flocculation tanks have been estimated based on a mixing energy input equivalent to the loss of momentum of the water entering the tanks. This is a conservative estimate of the total mixing, since other energy losses occur during passage of the water from one tank to another. This additional mixing energy could result in G values which are as much as 25 percent higher. The actual energy loss can be obtained from precise hydraulic tests.

Useful flocculation velocity gradients range from 100 to <10 sec^{-1}. A "tapered" or stepped series should be used; the highest mixing is provided initially, progressing through a series of cells of decreasing mixing levels. Additionally, the dimensionless parameter, Gt, which is the product of velocity gradient and the duration of mixing, is a most useful parameter which usually must have values within the range of 10^4 to 10^5.

Estimated Velocity Gradient at 10°C:

Flocculation Tanks 1 or 2	25 ML/d (Each Tank)	50 ML/d (Each Tank)
Cell 1	G = 36 s^{-1}	G = 102 s^{-1}
Cell 2 or 3	G = 6 s^{-1}	G = 14 s^{-1}
Overall	Gt = 3.9×10^4	Gt = 2.9×10^4
Total Plant Flow	50 ML/d	100 ML/d

(h) Settling Tanks

The settling tanks are horizontal cross-flow and are made of concrete.

(h) Settling Tanks (cont'd)

There are four identical settling tanks, each approximately 10.4 m x 34.5 m x 5.1 m deep. The total volume and surface areas of the settling tanks are 7320 m^3 and 1435 m^2, respectively. Assuming an even split of flow to the four tanks, the settling detention times at 100 and 50 ML/d are 105 and 210 minutes, respectively. For similar flow conditions, the overflow rates are 2.9 and 1.45 m/h, respectively.

(i) Filters

The Peterborough Water Filtration Plant has a total of 11 filters. Plant 1 has nine filters, numbered 1 to 9 and Plant 2 has two filters numbered 1 and 2. The information on filter media is based on information provided by the Plant Superintendent.

All filter boxes are constructed of concrete, and all filters have surface agitators. The filters have constant rate controllers with clearwell level override; however, the filters do not always operate at a constant rate. The operator manually adjusts the filtration rates throughout the day to maintain the clearwell and settled water levels.

Filters 1 and 2 in Plant 2 are operated all of the time and filter approximately 60% of the settled water flow. Filters 5-9, Plant 1 are operated most of the time, but at a lower filtration rate than those in Plant 2. Filters 1-4, Plant 1 are sand filters. These operate at the lowest filtration rate, and are not operated all of the time. When these filters are converted to dual media in 1988, the filtration rates should be similar to Filters 5-9.

The Peterborough Utilities Commission comments that shorter filter runs are experienced with the Ecodyne nozzle underdrains (Plant 1, Filter 8). The length of the filter runs with Ecodyne underdrains are approximately 60% to 70% of the filter runs experienced with Leopold block underdrains (Plant 1, Filters 7 and 9 and Plant 2, Filters 1 and 2).

(i) Filters (cont'd)

FILTERS 1-6, PLANT 1 (1922)

	W (m)	L (m)	(1) D (m)	SURFACE AREA (m^2)
Individual	5.34	7.32	2.74	39.1
Total				234.5

NOTES:

(1) D (m) is depth of water in the filter box in metres.
Filters 1-6 have copper lateral underdrains.
The filter media depth is as follows:

		DEPTH (m)	
	Particle Size (mm)	Filters 1-4*	Filters 5-6
Anthracite	0.9 - 1.2	-	0.305
Sand #2	0.5 - 0.8	0.508	0.356
Sand #1	1.19 - 2.38	-	0.051
Gravel	1.59 - 3.18	0.076	-
Gravel	3.18 - 6.35	0.089	-
Gravel	6.35 - 12.7	0.089	-
Gravel	12.7 - 19.0	0.102	-
Gravel	2.36 - 4.7	-	0.076
Gravel	4.7 - 9.5	-	0.051
Gravel	9.5 - 19.0	-	0.051
Gravel	19.0 - 38.1	0.102	0.051

* Filters 1-4 will be changed to dual media (same as Filters 7&9) in 1988, and will have Leopold block underdrains installed.

(i) Filters (cont'd)

FILTERS 7-9, PLANT 1 (1952)

	W (m)	L (m)	(1) D (m)	SURFACE AREA (m^2)
Individual	5.34	7.32	2.74	39.1
Total				117.3

NOTES:

(1) D (m) is depth of water in the filter box in metres.
Filters 7 and 9 have Leopold clay underdrains.
Filter 8 has Ecodyne nozzle underdrains.
The filter media depth is as follows:

		DEPTH (m)	
	Particle Size (mm)	Filters 7 & 9	Filter 8
Anthracite	0.9 - 1.2	0.432	0.432
Sand #2	0.5 - 0.8	0.152	0.152
Sand #1	1.19 - 2.38	0.076	0.127
Gravel	2.36 - 4.7	0.051	-
Gravel	4.7 - 9.5	0.051	-
Gravel	9.5 - 19.0	0.051	-

(i) Filters (cont'd)

FILTERS 1-2, PLANT 2 (1965)

	W (m)	L (m)	(1) D (m)	SURFACE AREA (m^2)
Individual	6.55	12.8	3.05	83.9
Total				167.8

NOTES:

(1) D (m) is depth of water in the filter box in metres.
Filters 1 and 2 have Leopold clay underdrains.
The filter media depth in Filters 1 and 2 is as follows:

		DEPTH (m)
	Particle Size (mm)	Filters 1 & 2
Anthracite	0.9 - 1.2	0.305
Sand #2	0.5 - 0.8	0.229
Sand #1	1.19 - 2.38	0.076
Gravel #4	2.36 - 4.7	0.051
Gravel #3	4.7 - 9.5	0.076
Gravel #2	9.5 - 19.0	0.076

(i) Filters (cont'd)

Raw Turbidity Range (FTU)	0.22 - 1.25 Based on readings obtained by the lab technician taking a daily raw water grab sample and measuring the turbidity with the laboratory HF Model DRT 1000 turbidimeter.
Effluent Turbidity Range (FTU)	0.12 - 0.51 Based on readings obtained by the lab technician taking a daily plant effluent grab sample and measuring the turbidity with a laboratory HF Model DRT 1000 turbidimeter.
Length of Run	24 hours, based on summer raw water quality and average flows. Filter runs can be as short as 12 hrs. with poor summer conditions, or as long as 10 days or more with good winter conditions, based on a head loss of 1.8 m. (Filter runs as long as 30 days in 1970 did not experience any problems).
Headloss (Clean Bed/Dirty Bed)	0.3 - 1.83 m.

Flow Rate

Total Flow (ML/d)	Split Flow (ML/d)	Filtration Rate	
		Plant 1 Filters 1-9*	Plant 2 Filters 1-2
100	40/60	4.7 m/h	14.9 m/h**
50	20/30	2.35 m/h	7.45 m/h

Backwash Flow	(Plant 1) Filters 1-6	low 20 m/hr high 26 m/hr
	(Plant 1) Filters 7-9	low 17 m/hr high 31 m/hr
	(Plant 2) Filters 1-2	low 10 m/hr high 23 m/hr
Water Filtered/Cycle +	Filters 1-4	30-60 m^3/m^2 range (Plant 1)
	Filters 5-9	50-115 m^3/m^2 range (Plant 1)
	Filters 1-2	125-240 m^3/m^2 range (Plant 2)
Backwash Water/Wash ~	Plant 1:	4.1 - 4.6 m^3/m^2 range
	Plant 2:	5.4 - 6.8 m^3/m^2 range

* Assuming filtration rates through Filters 1-9 are equal.

** Exceeds MOE Design Guidelines, however, given the low raw water turbidity, the solids loading is correspondingly low, even at these higher flowrates.

+ Amount of water filtered through various filters between backwashes, expressed as a volume of filtered water per unit area of filter bed, based on estimates provided by the Utilities Commission but not confirmed by tests.

~ Volume of water used to backwash a filter, expressed as a volume of water per unit area of filter bed.

(i) Filters (cont'd)

The backwash water system consists of two centrifugal pumps which draw water from the Plant No. 2 clearwell, each with a rated capacity of 45.4 ML/d at a head of about 15 m of water.

(j) Clearwells

There are two clearwells and a reservoir at the Peterborough Water Filtration Plant. All are constructed of concrete.

Clearwell under Plant 1	0.615 ML
Clearwell under Plant 2	0.940 ML
Reservoir	9.7 ML
TOTAL	11.255 ML

(k) High Lift Pumping

The Zone 1 high lift pumping station has a cast iron suction header. The Zone 2 high lift pumping station has concrete pipe as a suction header. The Zone 1 pumphouse is located approximately 1 km downstream of the plant.

All Zone 1 pumps are horizontal turbine.
All Zone 2 pumps are vertical centrifugal.

PUMPS	PUMP NO.	TYPE	CAPACITY (ML/d)	POWER (kW)	HEAD (m)	MANUFACTURER
Zone 1	1	Water Turbine	17.7	186.4	74.7	Dominion Engineering
	2	Water Turbine	17.7	186.4	74.7	Dominion Engineering
	3	Electric	27.2	298.3	74.7	Ingersol Rand
	4	Water Turbine/ Electric	20.4	261.0	74.7	Dominion Engineering
	5	Electric	17.7	223.7	74.7	DeLaval
Zone 2	1	Electric/Diesel	13.6	149.1	79.3	Allis & Chalmers
	2	Electric	22.7	74.6	79.3	Worthington
	3	Electric	18.2	223.7	79.3	Allis & Chalmers
		TOTAL INSTALLED	155.2			
		FIRM CAPACITY	128			

(k) High Lift Pumping (cont'd)

There is a common chemical application point on the suction side of the high lift piping where chlorine and fluoride are applied which is refered to as the "junction chamber".

(l) Backwash Treatment

Presently, the plant has no waste treatment facilities. The backwash water is drained directly into the Otonabee River. The City of Peterborough Water Pollution Control study investigated the effect of the backwash water discharge on the Otonabee River. The test results indicated that the total and fecal coliform levels of the discharge were zero.

(m) Settling Tank Waste

The settling tank sludge is also drained into the Otonabee River. The tanks are cleaned approximately once a month from May to October. A coagulant is not used during the winter months, and therefore, the settling tanks do not require cleaning during those months.

C.3 Chemical Systems

(a) Disinfectant

Chlorine is stored as a liquid in 0.9 tonne cylinders.

Application points:

Pre- Intake well, just upstream of the screens.

Post- Junction chamber (common point before Zone 1 and Zone 2 high lift suctions)

Equipment:

Pre- 2 - 909 kg/d Wallace & Tiernan gas chlorinator
1 - Wallace & Tiernan continuous chlorine analyzer

Post- 1 - 227 kg/d Wallace & Tiernan gas chlorinator (or sulphonator)
1 - Wallace & Tiernan continuous chlorine analyzer for compound loop control of chlorine feed (or sulphur dioxide feed) based on chlorine residual.

(a) Disinfectant (cont'd)

As only one pre-chlorine feeder is used at a time, the total pre-chlorine feed rate is 909 Kg/d. This results in a maximum dosage of 9.1 and 18.2 mg/L for 100 and 50 ML/d, respectively. The post chlorine feed rate of 227 Kg/d results in a maximum dosage of 2.3 and 4.5 mg/L for 100 and 50 ML/d, respectively.

(b) Coagulant

The liquid coagulant, alum or polyaluminum chloride (PACl) is stored in two fibreglass storage tanks. The capacity of each tank is 15,890 L. At the time of this study, PACl was used as the coagulant.

PACl is fed directly from the storage tanks with a single-head diaphragm metering pump. There is an abandoned 500 L day tank which is part of the system. The metering pump has a manual stroke adjustment, and the speed is flow paced from the time pulse raw water flow signal. The metering pump has a converter which changes the signal from a time pulse to a 4-20 mA signal. The pump is a Wallace & Tiernan Model 44-115 metering pump with a maximum capacity of 6.3 L/min. The maximum dosage capacity of the pump is 59 and 118 mg/L for 100 and 50 ML/d, respectively.

In the near future, a second chemical metering pump will be added at the Peterborough plant. The pump will be a Milton Roy Model SFR162-96 metering pump with a maximum capacity of 3.785 L/min. The pump has a manual stroke adjustment and the capability for adding a process controller.

The PACl is applied via a diffusor into the raw water header. The present use of PACl is on a trial basis. The plant may return to using alum as its coagulant.

(c) Fluoride

Fluoride is added in the form of hydrofluosilicic acid. The acid is stored in two 11,350 fiberglass tanks with PVC bag liners.

(c) Fluoride (cont'd)

Fluoride is fed from one of two 450 L day tanks with a dual-head diaphragm metering pump. The speed of the metering pump is flow paced from the summated treated water time pulse signal. The addition of fluoride is controlled by a compound loop system. The one head of the pump has a manual stroke adjustment while the other pump head is dosage controlled by a 4 to 20 mA signal from the fluoride analyzer.

The pump is a Wallace & Tiernan Model 44-222 metering pump with a maximum capacity of 0.76 L/min. The maximum dosage capacity of the pump is 2.6 and 5.2 mg/L for 100 and 50 ML/d, respectively.

The application point is at the junction chamber (common point) before the treated water separates to go to Zones 1 and 2. The compound loop fluoride analyzer samples the Zone 2 plant effluent.

(d) Dechlorination

Sulphur dioxide is stored as a liquid in 0.9 tonne cylinders.

The application point is at the junction chamber (common point) before the treated water separates to go to Zones 1 and 2. The superchlorination/dechlorination process is practiced during extremely cold and warm raw water conditions.

Equipment:

1 - 227 kg/d Wallace & Tiernan sulphonator (or chlorinator)

1 - Wallace & Tiernan continuous chlorine analyzer for compound loop control of sulphur dioxide feed (or post chlorine feed) based on chlorine residual.

The total sulphur dioxide feed rate of 227 Kg/d results in a maximum dosage of 2.3 and 4.5 mg/L for 100 and 50 ML/d, respectively.

(e) Taste and Odour

The Peterborough plant has powdered activated carbon feed equipment which was used for several weeks in 1980-1981 to reduce taste and odour problems.

The powdered activated carbon is stored in bags. It is manually loaded into a Wallace & Tiernan dry feeder. The capacity of the feeder is 180 Kg/d; thus, the maximum dosages are 1.8 and 3.6 mg/L for 100 and 50 ML/d, respectively.

The powdered activated carbon is normally applied into the low lift suction well.

C.4 Drawings

(a) Site Plan

Following is a site plan of the Peterborough Water Treatment Plant.

(b) Process and Piping Diagram

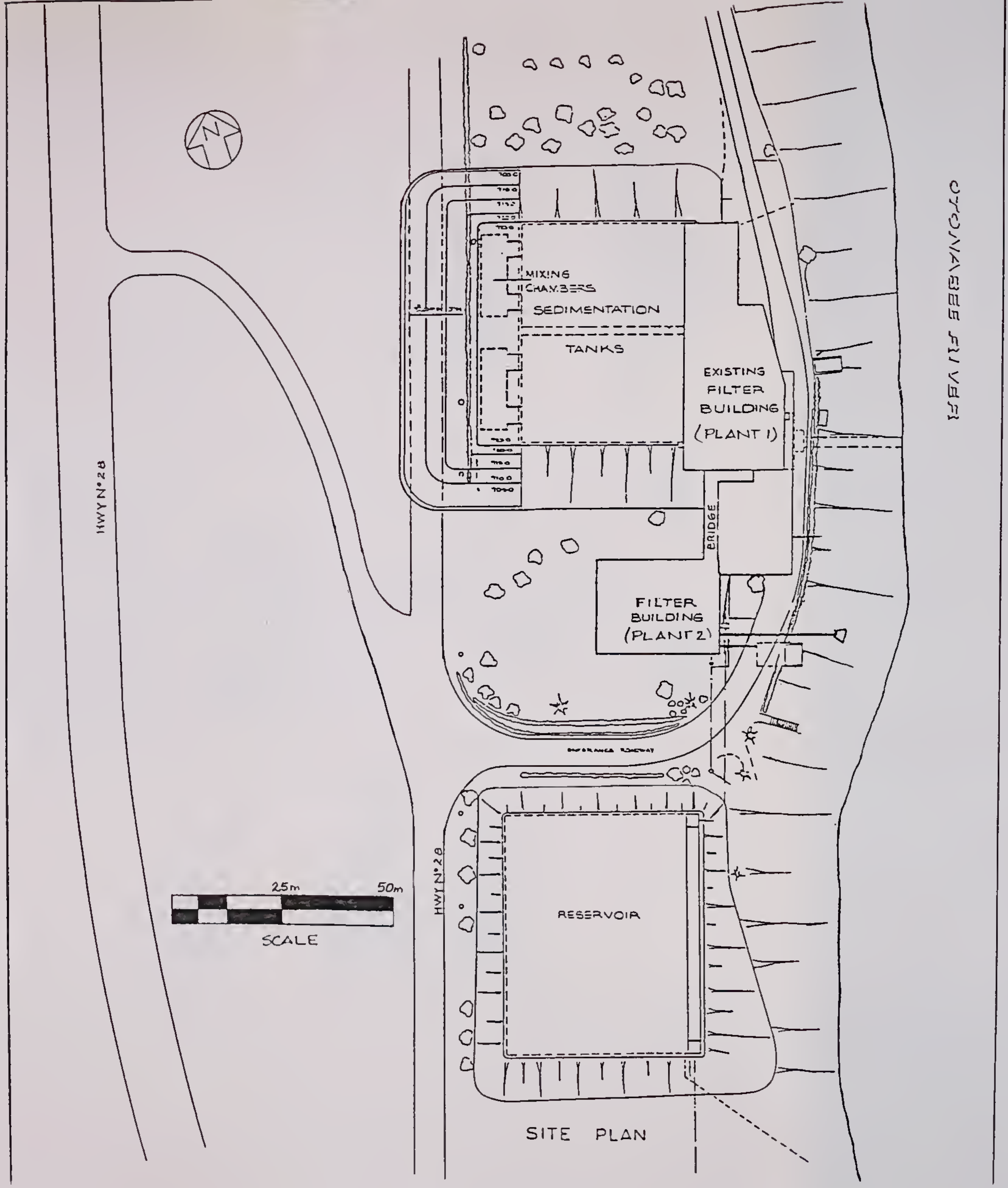
A process flow and piping diagram was not available from the record drawings.

(c) Block Schematic

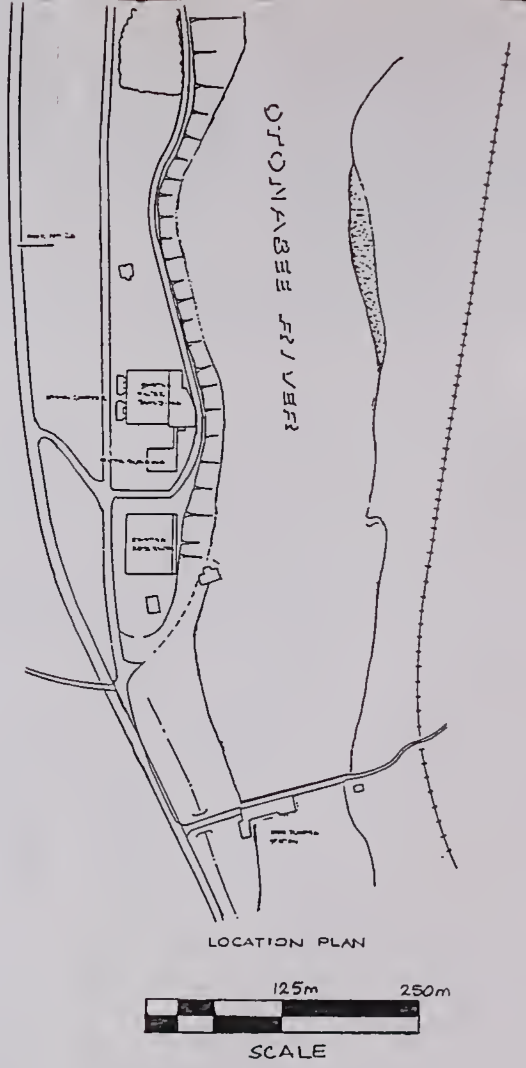
Following is a block flow diagram of the Peterborough Plant.

(d) Photographs

Following is a series of photographs to illustrate major components and chemical feed systems.



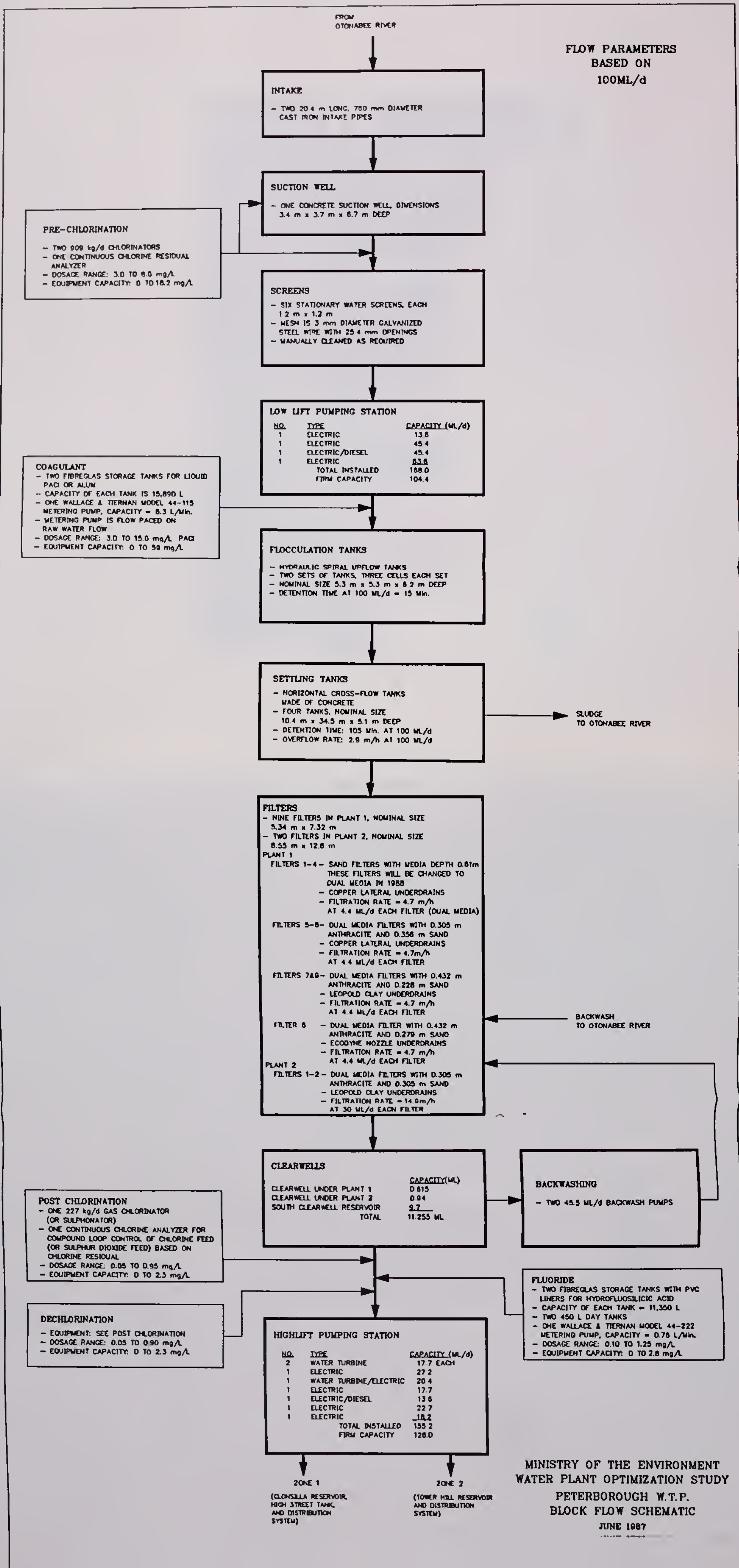
SITE PLAN



LOCATION PLAN

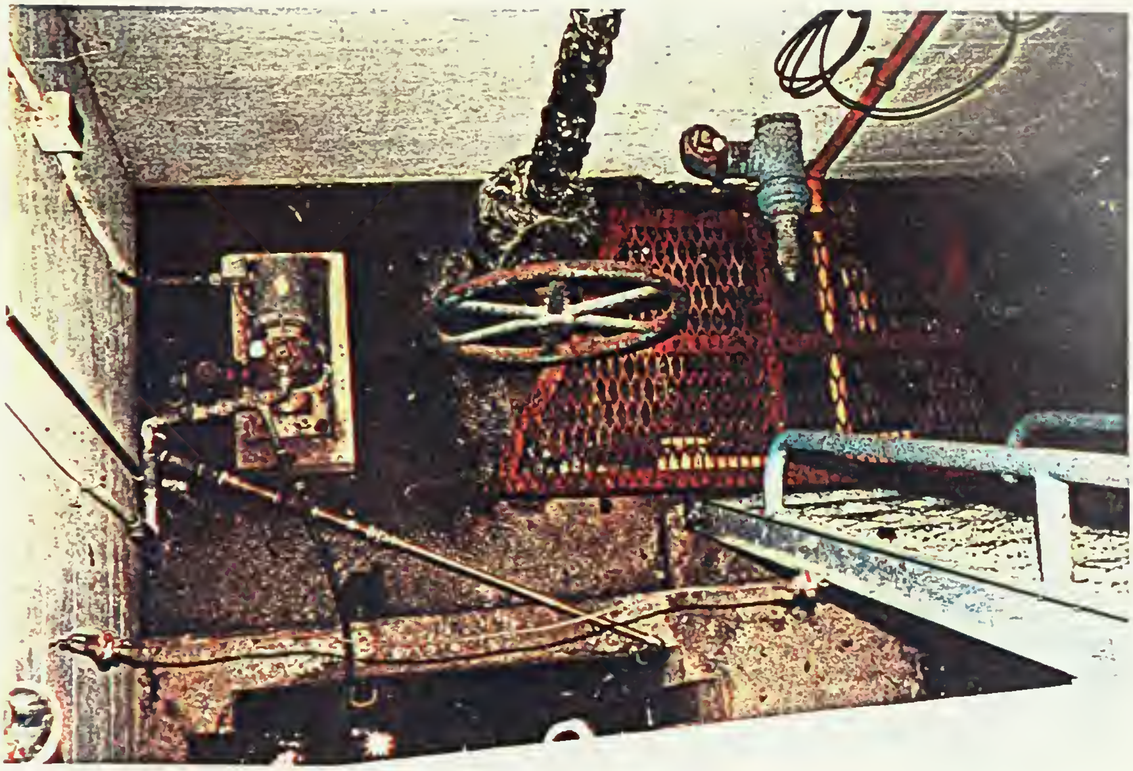
PETERBOROUGH UTILITIES COMMISSION
WATER PURIFICATION PLANT
SITE PLAN

N° | DATE | APPR'V'D | CONSTR'D
REVISIONS
DRAWN BY
CHECKED BY


FROM OTONABEE RIVER
FLOW PARAMETERS BASED ON 100ML/d
INTAKE
- TWO 20.4 m LONG, 760 mm DIAMETER CAST IRON INTAKE PIPES
SUCTION WELL
- ONE CONCRETE SUCTION WELL, DIMENSIONS 3.4 m x 3.7 m x 6.7 m DEEP
PRE-CHLORINATION
- TWO 909 kg/d CHLORINATORS
- ONE CONTINUOUS CHLORINE RESIDUAL ANALYZER
- DOSAGE RANGE: 3.0 TO 6.0 mg/L
- EQUIPMENT CAPACITY: 0 TO 18.2 mg/L
SCREENS
- SIX STATIONARY WATER SCREENS, EACH 1.2 m x 1.2 m
- MESH IS 3 mm DIAMETER GALVANIZED STEEL WIRE WITH 25.4 mm OPENINGS
- MANUALLY CLEANED AS REQUIRED
LOW LIFT PUMPING STATION
NO. TYPE CAPACITY (ML/d)
1 ELECTRIC 13.6
1 ELECTRIC 45.4
1 ELECTRIC/DIESEL 45.4
1 ELECTRIC 63.6
TOTAL INSTALLED 168.0
FIRM CAPACITY 104.4
COAGULANT
- TWO FIBREGLAS STORAGE TANKS FOR LIQUID PACI OR ALUM
- CAPACITY OF EACH TANK IS 15,890 L
- ONE WALLACE & TIERNAN MODEL 44-115 METERING PUMP, CAPACITY = 6.3 L/Min.
- METERING PUMP IS FLOW PACED ON RAW WATER FLOW
- DOSAGE RANGE: 3.0 TO 15.0 mg/L PACI
- EQUIPMENT CAPACITY: 0 TO 59 mg/L
FLOCCULATION TANKS
- HYDRAULIC SPIRAL UPFLOW TANKS
- TWO SETS OF TANKS, THREE CELLS EACH SET
- NOMINAL SIZE 5.3 m x 5.3 m x 6.2 m DEEP
- DETENTION TIME AT 100 ML/d = 15 Min.
SETTLING TANKS
- HORIZONTAL CROSS-FLOW TANKS MADE OF CONCRETE
- FOUR TANKS, NOMINAL SIZE 10.4 m x 34.5 m x 5.1 m DEEP
- DETENTION TIME: 105 Min. AT 100 ML/d
- OVERFLOW RATE: 2.9 m/h AT 100 ML/d
SLUDGE TO OTONABEE RIVER
FILTERS
- NINE FILTERS IN PLANT 1, NOMINAL SIZE 5.34 m x 7.32 m
- TWO FILTERS IN PLANT 2, NOMINAL SIZE 8.55 m x 12.8 m
PLANT 1
FILTERS 1-4 - SAND FILTERS WITH MEDIA DEPTH 0.61m THESE FILTERS WILL BE CHANGED TO DUAL MEDIA IN 1988
- COPPER LATERAL UNDERDRAINS
- FILTRATION RATE = 4.7 m/h AT 4.4 ML/d EACH FILTER (DUAL MEDIA)
FILTERS 5-6 - DUAL MEDIA FILTERS WITH 0.305 m ANTHRACITE AND 0.356 m SAND
- COPPER LATERAL UNDERDRAINS
- FILTRATION RATE = 4.7m/h AT 4.4 ML/d EACH FILTER
FILTERS 7&8 - DUAL MEDIA FILTERS WITH 0.432 m ANTHRACITE AND 0.228 m SAND
- LEOPOLD CLAY UNDERDRAINS
- FILTRATION RATE = 4.7 m/h AT 4.4 ML/d EACH FILTER
FILTER 9 - DUAL MEDIA FILTER WITH 0.432 m ANTHRACITE AND 0.279 m SAND
- ECODYNE NOZZLE UNDERDRAINS
- FILTRATION RATE = 4.7 m/h AT 4.4 ML/d EACH FILTER
PLANT 2
FILTERS 1-2 - DUAL MEDIA FILTERS WITH 0.305 m ANTHRACITE AND 0.305 m SAND
- LEOPOLD CLAY UNDERDRAINS
- FILTRATION RATE = 14.9m/h AT 30 ML/d EACH FILTER
BACKWASH TO OTONABEE RIVER
CLEARWELLS
CAPACITY(ML)
CLEARWELL UNDER PLANT 1 0.615
CLEARWELL UNDER PLANT 2 0.94
SOUTH CLEARWELL RESERVOIR 9.7
TOTAL 11.255 ML
BACKWASHING
- TWO 45.5 ML/d BACKWASH PUMPS
POST CHLORINATION
- ONE 227 kg/d GAS CHLORINATOR (OR SULPHONATOR)
- ONE CONTINUOUS CHLORINE ANALYZER FOR COMPOUND LOOP CONTROL OF CHLORINE FEED (OR SULPHUR DIOXIDE FEED) BASED ON CHLORINE RESIDUAL
- DOSAGE RANGE: 0.05 TO 0.95 mg/L
- EQUIPMENT CAPACITY: 0 TO 2.3 mg/L
DECHLORINATION
- EQUIPMENT: SEE POST CHLORINATION
- DOSAGE RANGE: 0.05 TO 0.90 mg/L
- EQUIPMENT CAPACITY: 0 TO 2.3 mg/L
FLUORIDE
- TWO FIBREGLAS STORAGE TANKS WITH PVC LINERS FOR HYDROFLUOSILICIC ACID
- CAPACITY OF EACH TANK = 11,350 L
- TWO 450 L DAY TANKS
- ONE WALLACE & TIERNAN MODEL 44-222 METERING PUMP, CAPACITY = 0.78 L/Min.
- DOSAGE RANGE: 0.10 TO 1.25 mg/L
- EQUIPMENT CAPACITY: 0 TO 2.6 mg/L
HIGHLIFT PUMPING STATION
NO. TYPE CAPACITY (ML/d)
2 WATER TURBINE 17.7 EACH
1 ELECTRIC 27.2
1 WATER TURBINE/ELECTRIC 20.4
1 ELECTRIC 17.7
1 ELECTRIC/DIESEL 13.6
1 ELECTRIC 22.7
1 ELECTRIC 18.2
TOTAL INSTALLED 155.2
FIRM CAPACITY 128.0
ZONE 1 (CLONSILLA RESERVOIR, HIGH STREET TANK, AND DISTRIBUTION SYSTEM)
ZONE 2 (TOWER HILL RESERVOIR AND DISTRIBUTION SYSTEM)

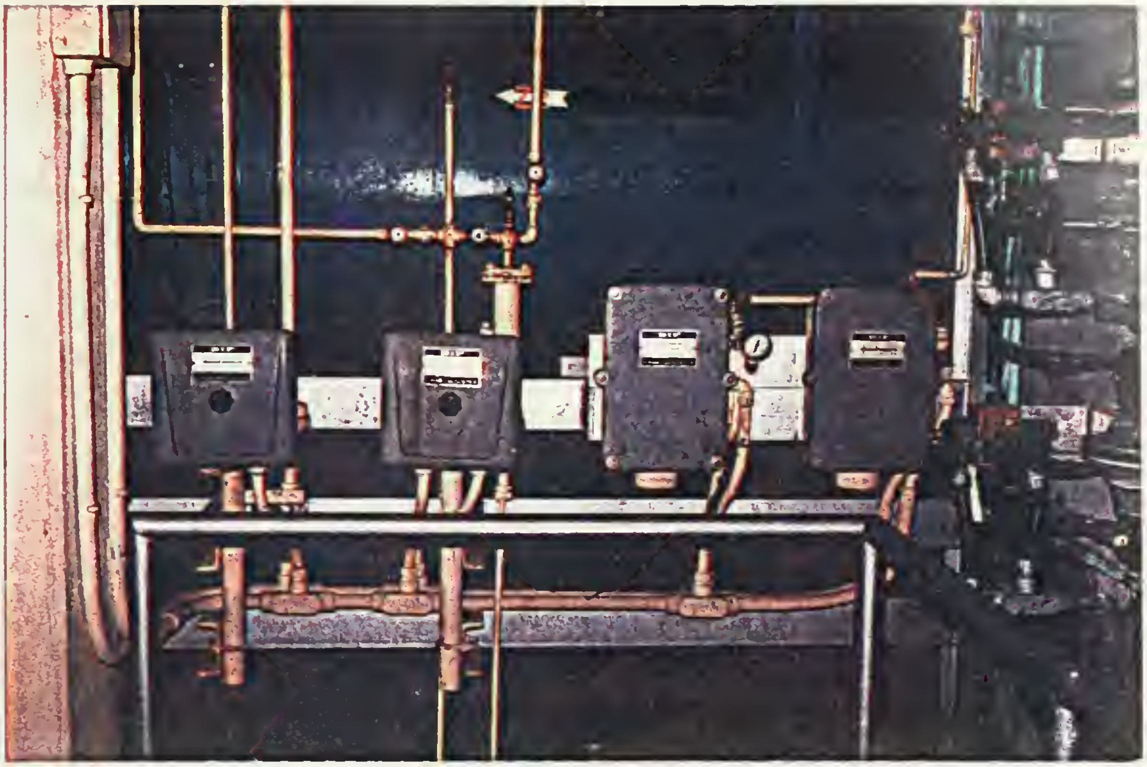
MINISTRY OF THE ENVIRONMENT
WATER PLANT OPTIMIZATION STUDY
PETERBOROUGH W.T.P.
BLOCK FLOW SCHEMATIC
JUNE 1987

ADMINISTRATION BUILDING - WALKWAY TO PLANT 2 AT LEFT



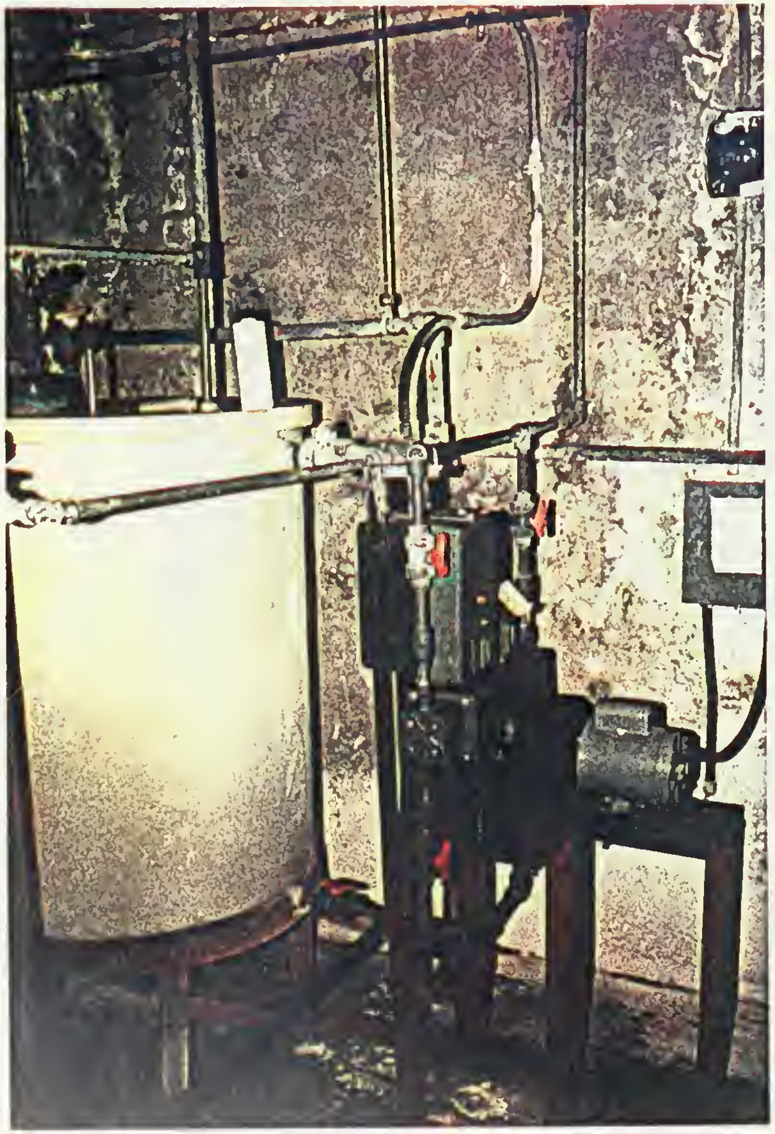
LEFT - RAW WATER SAMPLE PUMP
RIGHT - INTAKE WELL CHLORINATION APPLICATION POINT

STATIONARY WATER SCREENS

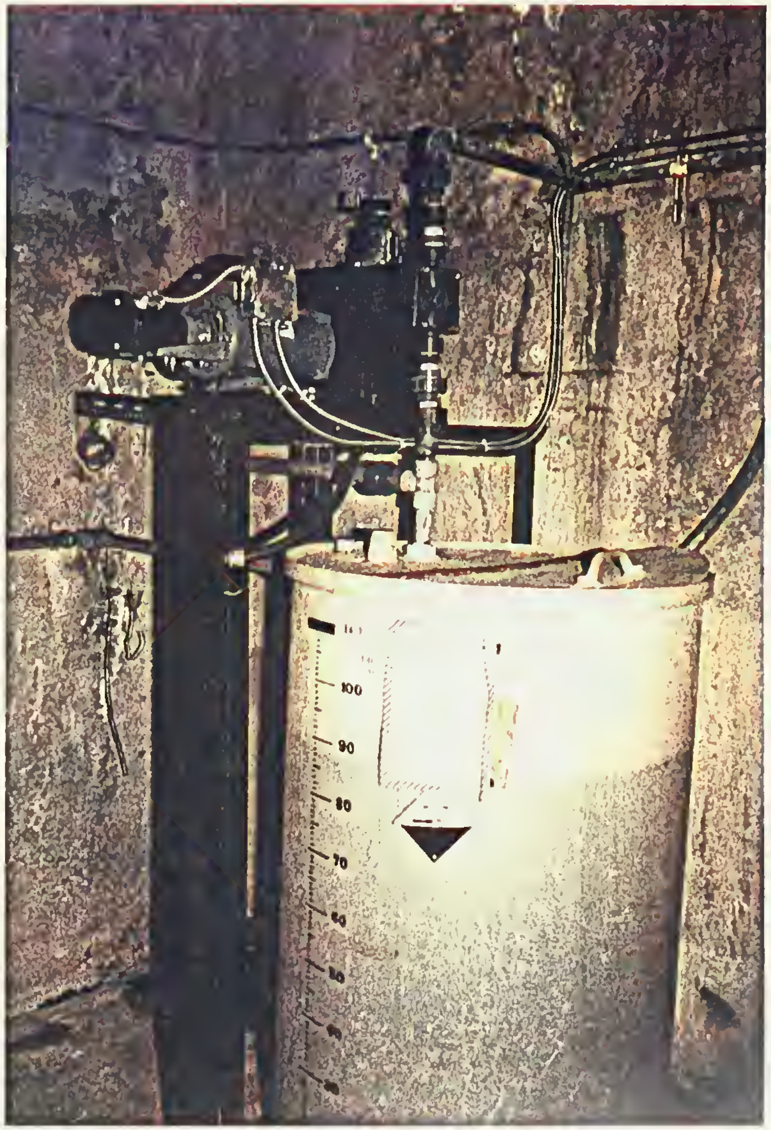


RAW AND TREATED WATER FLOW TRANSMITTERS

ALUM APPLICATION POINT INTO RAW WATER HEADER

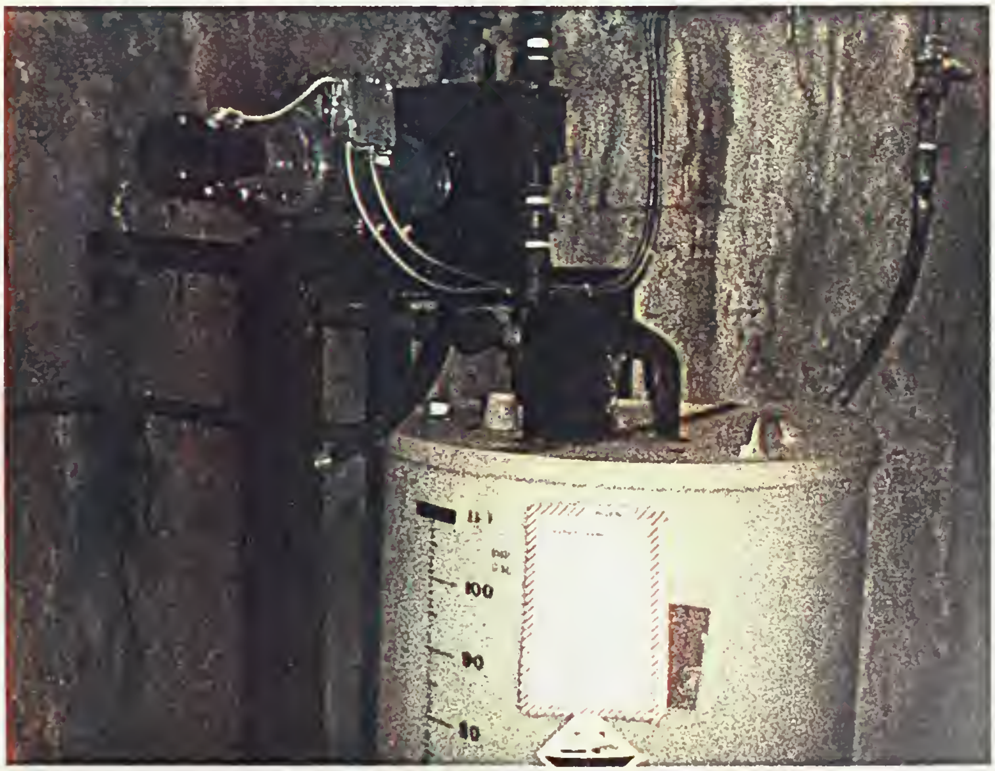


HYDROFLUOSILIC ACID DAY TANK



ABANDONED COAGULANT DAY TANK

FLUORIDE METERING PUMP



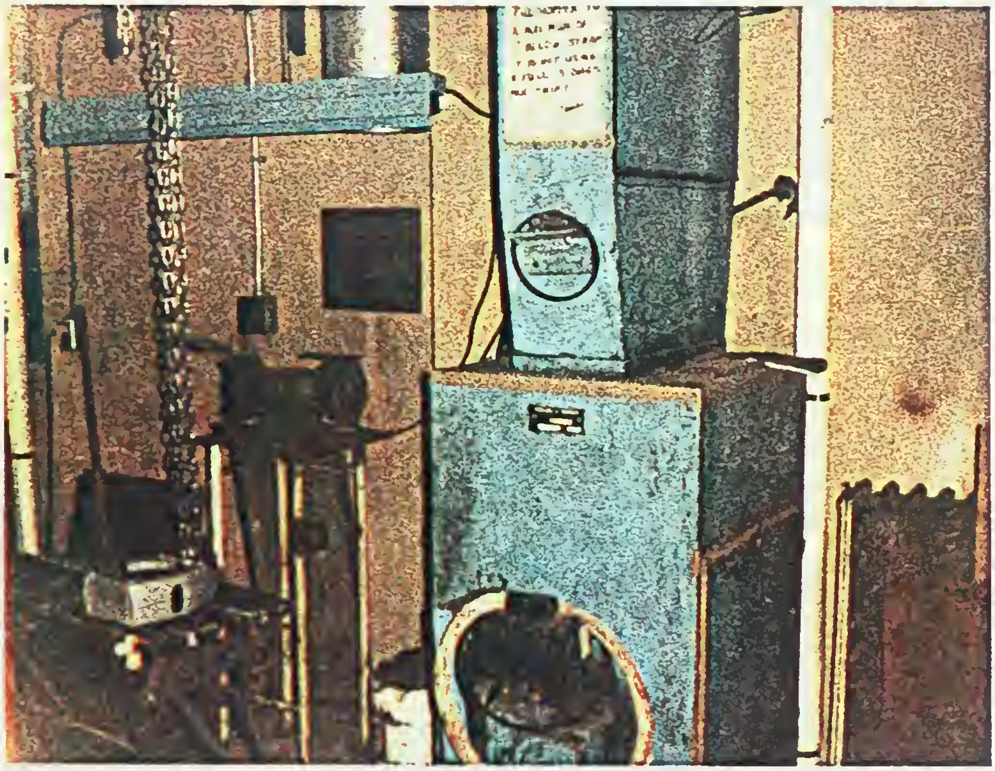
COAGULANT METERING PUMP

[illegible]

[illegible]

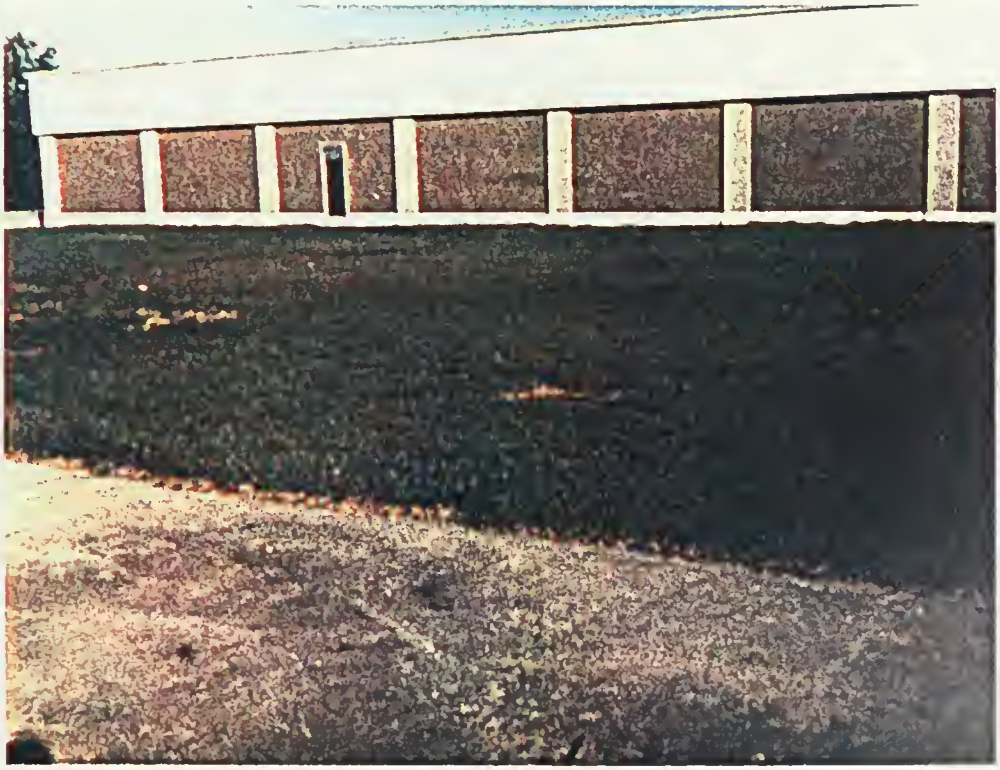
PACl STORAGE TANK

H_2SiF_6 STORAGE TANK

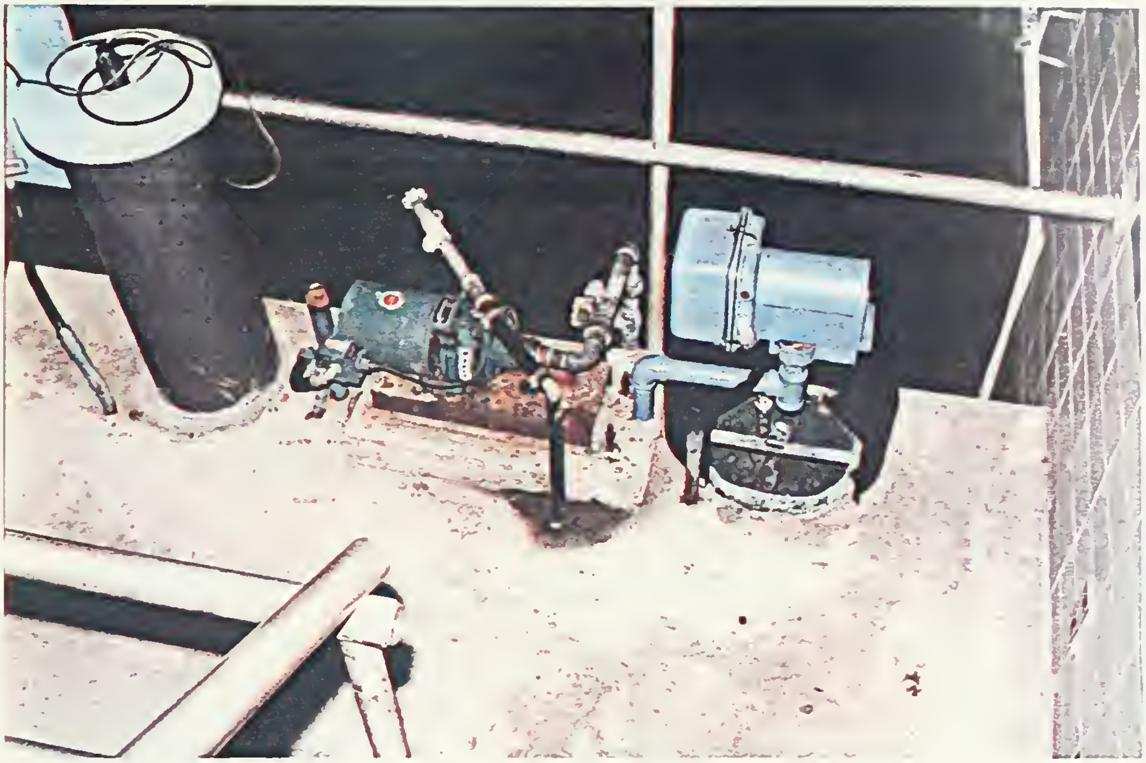


POWDERED ACTIVATED CARBON HOPPER

MIXING CHAMBERS



SETTLING TANKS



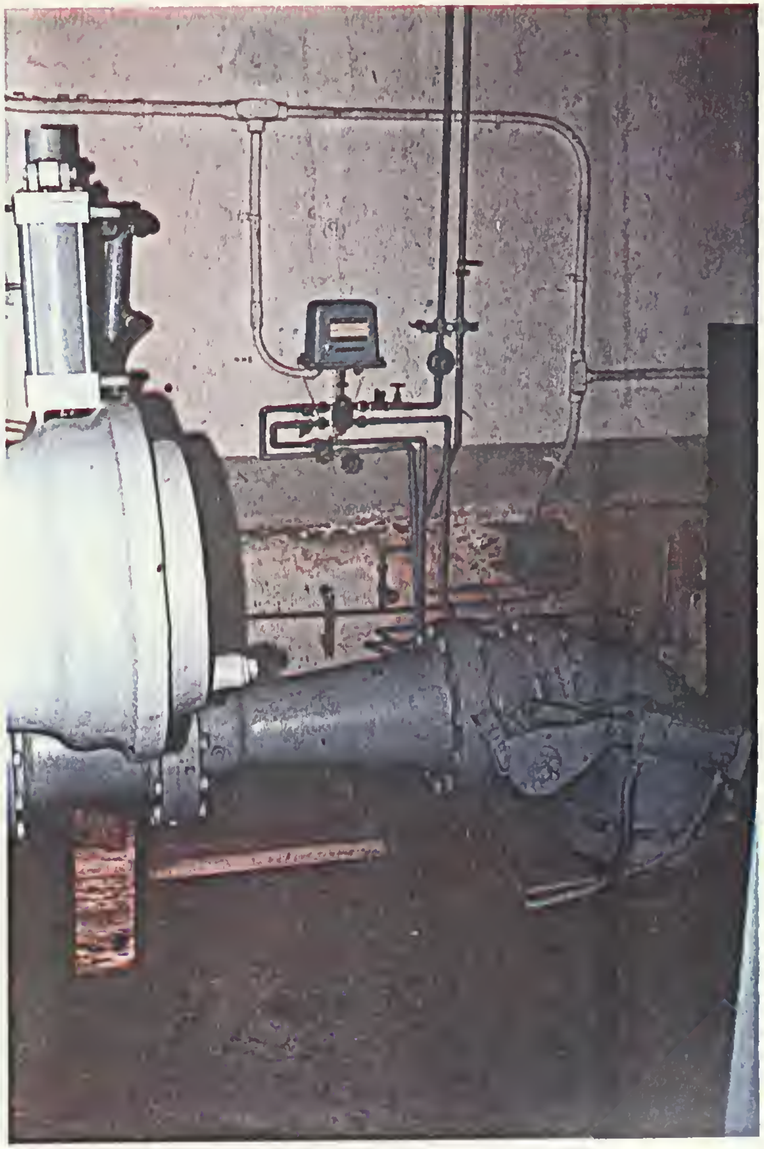
L TO R: SETTLED WATER LEVEL TRANSMITTER
SETTLED WATER SAMPLE PUMP (PLANT 1)

PLANT 2 SAMPLE PUMPS

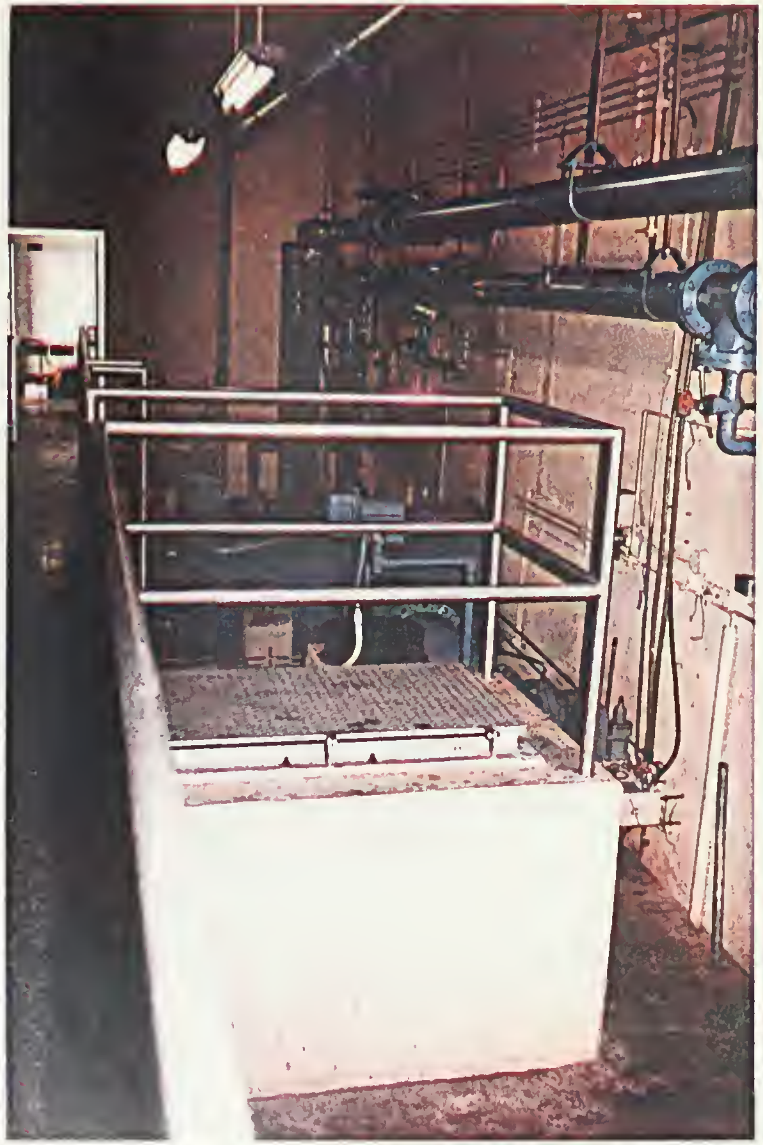
CHLORINATORS AND SULPHONATOR

PLANT 1, FILTER 9 - FILTER CONTROL PANEL

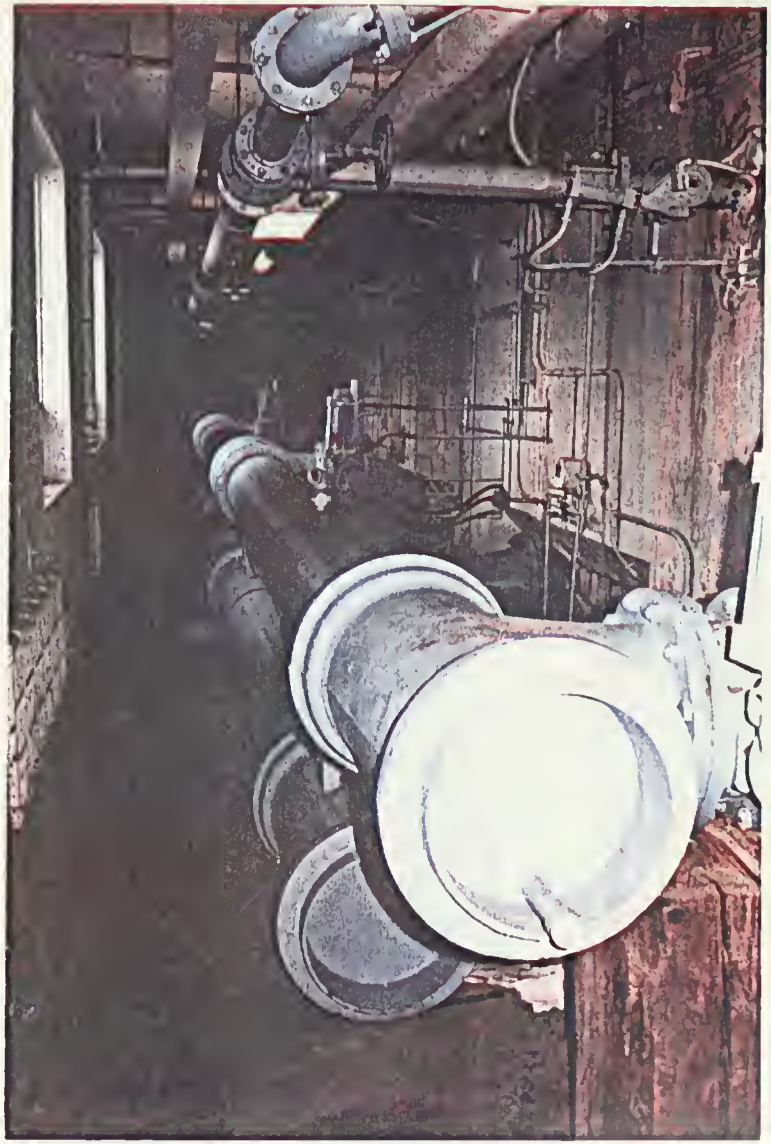
PLANT 1 – FILTER CONTROL PANEL



PLANT 1 FILTER CONTROLLER

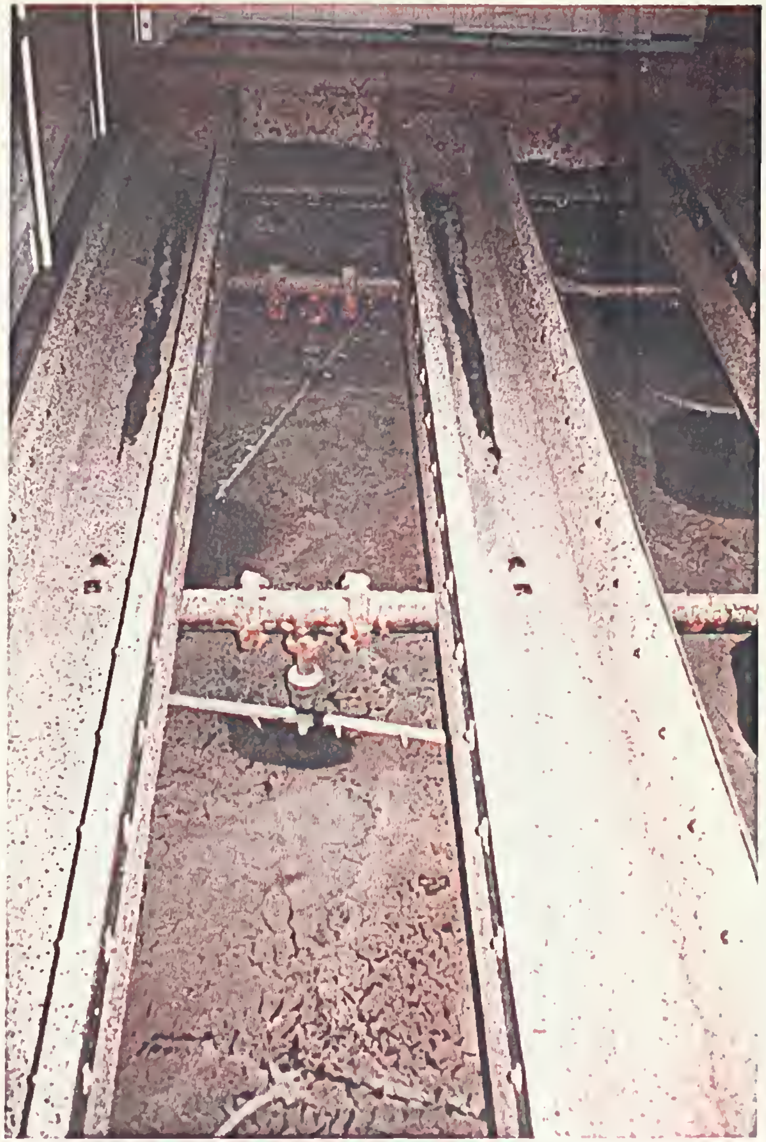


PLANT 2 PIPE GALLERY

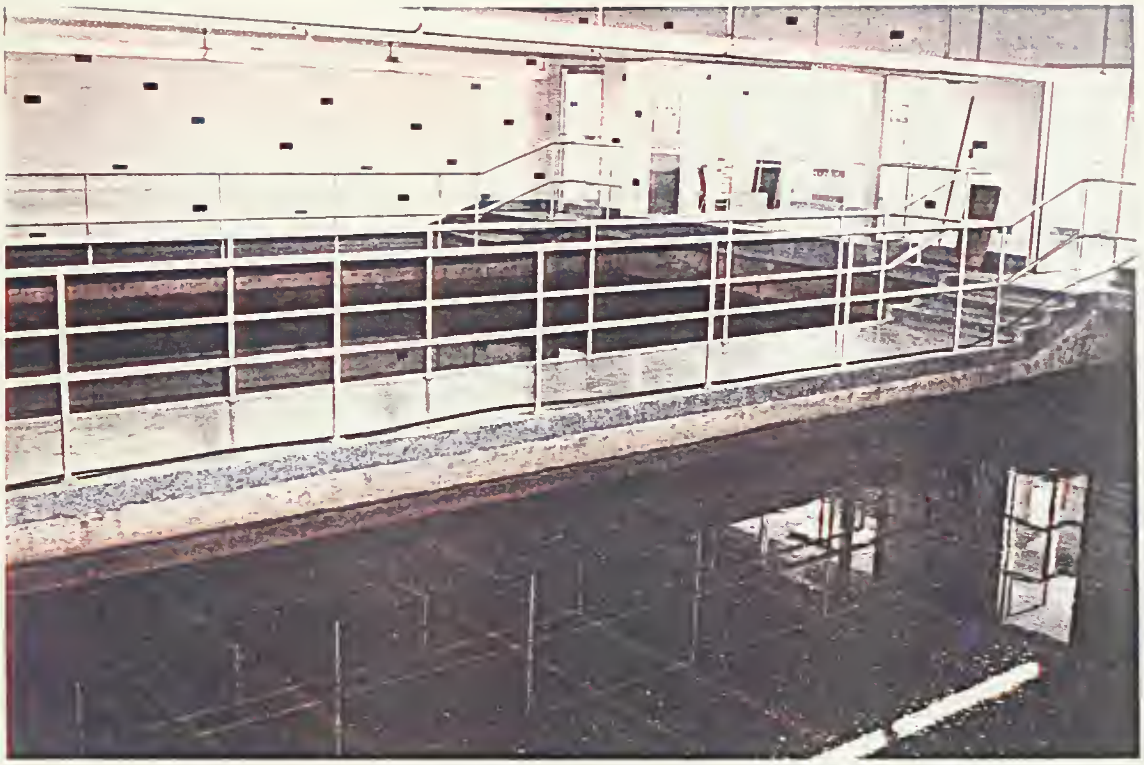


PLANT 1 PIPE GALLERY

CHLORINE AND SO_2 CYLINDER STORAGE BUILDING

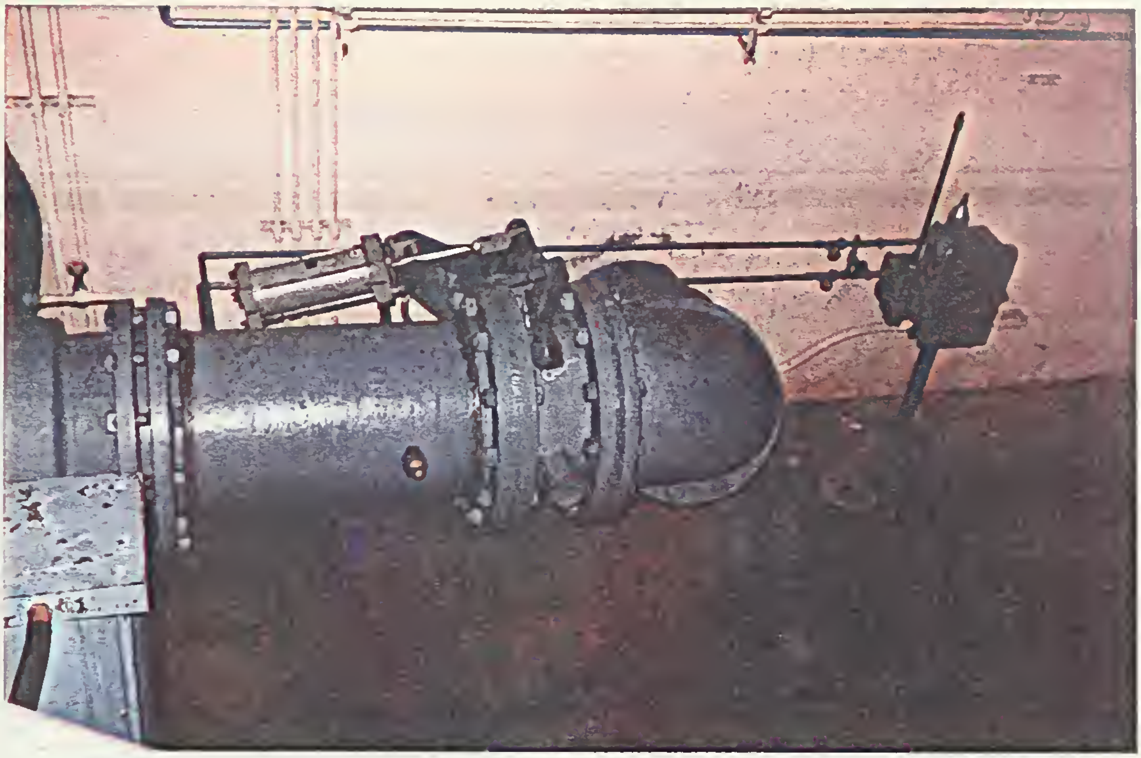


FILTER 4 - PLANT 1



FILTERS

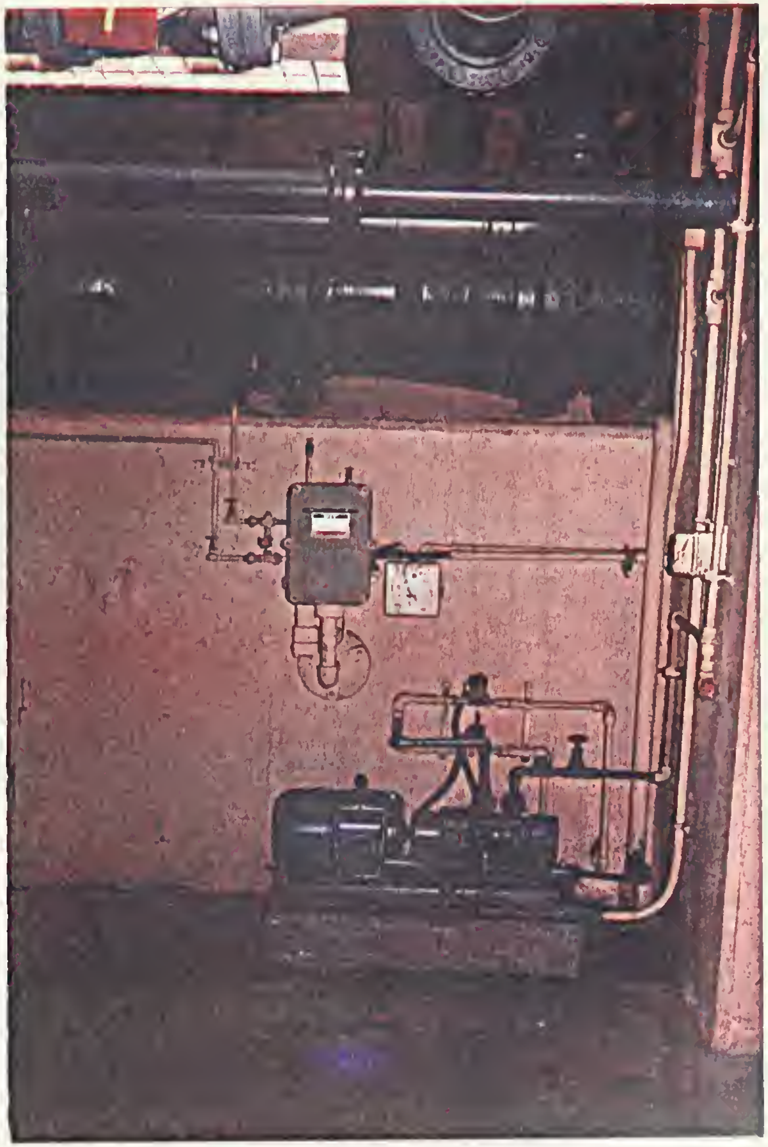
PLANT 1, FILTERS 5 AND 6



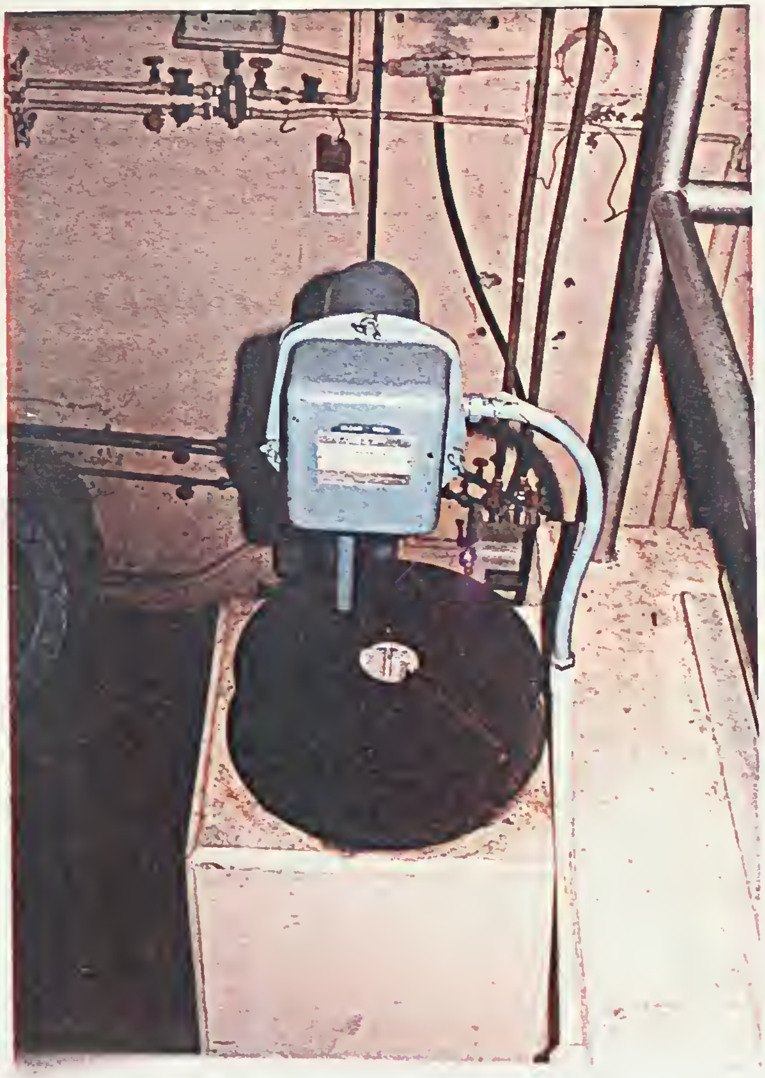
PLANT 1, FILTER 9 EFFLUENT FILTER PIPING

LABORATORY

BACKWASH PUMPS



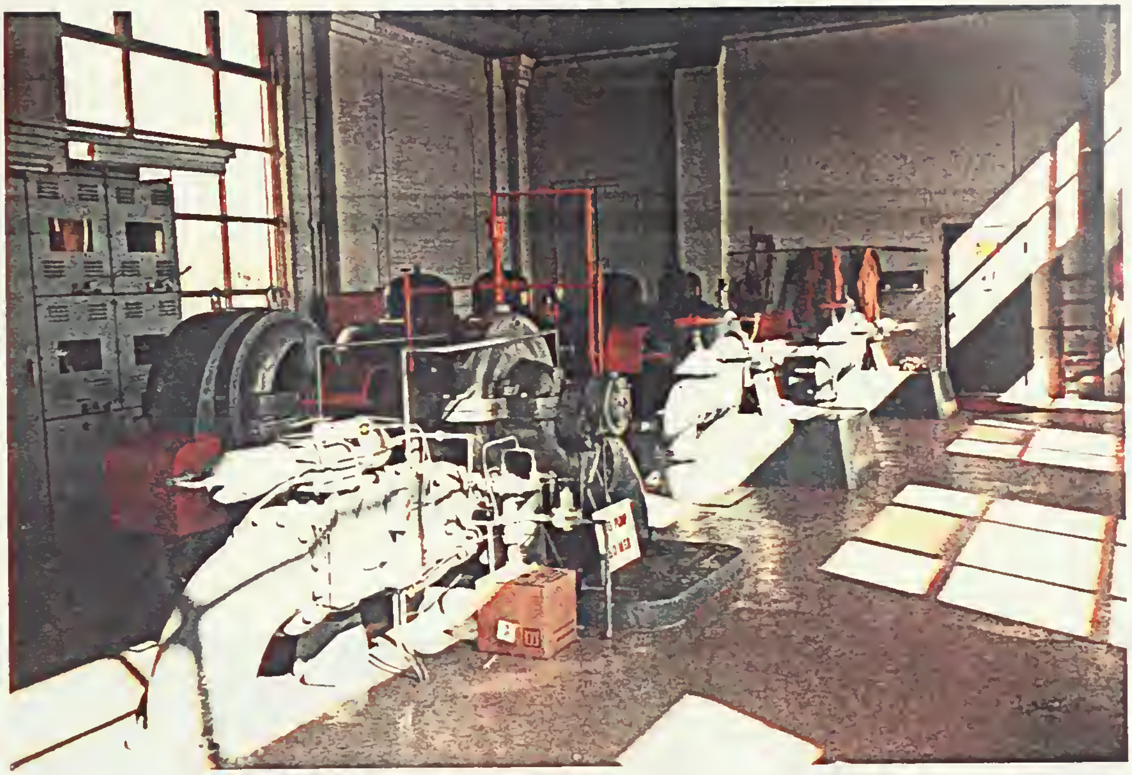
BOTTOM - SAMPLE PUMP
TOP - WASH WATER FLOW METER



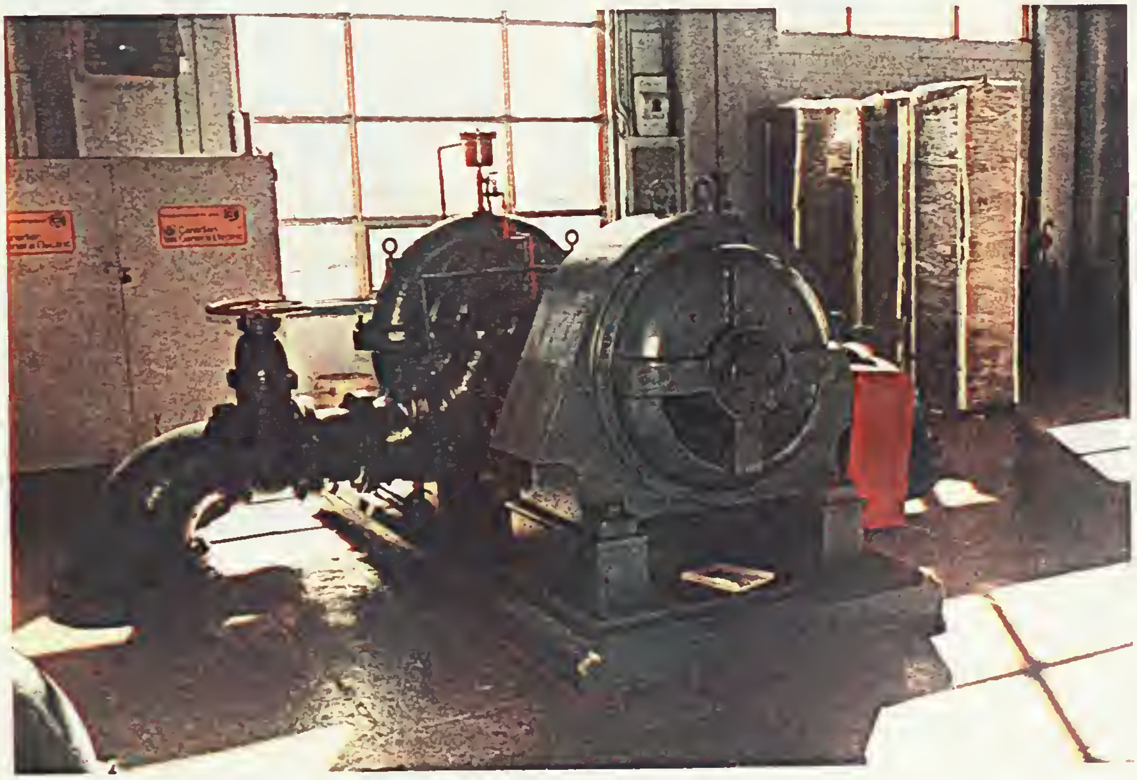
PLANT 2 - CLEARWELL LEVEL TRANSMITTER

RESERVOIR

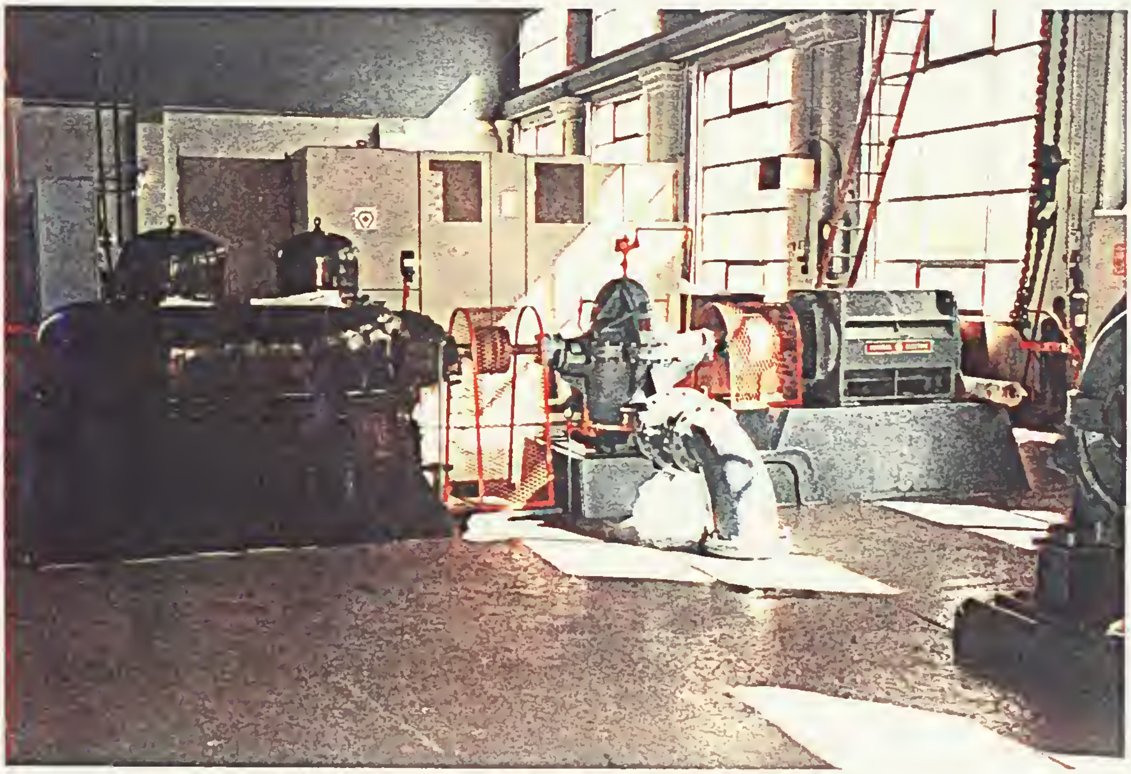
HIGH LIFT PUMPS (ZONE 2)



PETERBOROUGH PUMP HOUSE (ZONE 1)



HIGH LIFT PUMP



TURBINE DRIVEN HIGH LIFT PUMP

SECTION D

PLANT OPERATION

SECTION D
PLANT OPERATION

D.1 Description

(a) General

The operation of this plant is good. The plant effluent turbidity is consistently below 1.0 FTU and usually less than 0.5 FTU. The total trihalomethanes range from 20 to 284 μg/L.

(b) Flow Control

RAW WATER

The raw water control system consists of valves which are modulated by the signal of either of two settled water level transmitters. If the raw water flow is more than the combined filter flows, the rising settled water level would cause the raw water control valve to close. The reverse control mode would also occur.

FILTRATION

The above control system, which serves all the filters, is not normally used at the Peterborough plant. Instead, the filter flow rates are manually adjusted by the operator to match the low lift pump flow rate. The settled water conduit level has high and low alarms so the operator is alerted if the level is outside of the control band. In Plant 1, this control band is 125 mm, and in Plant 2, it is 175 mm. Normally the operators adjust the flow rate before the alarms. This manual mode of operation causes constant changes to filter flow rates, particularly during filter backwashing.

The plant production is dictated by the plant clearwell level, which is maintained at a level between 1.8 m to 3.1 m water depth.

(b) Flow Control (cont'd)

HIGH LIFT PUMPING

The Zone 1 high lift pumping units provide water for the distribution system and to fill the Clonsilla Reservoir which is maintained at a level of between 3 to 5 m water depth. The Zone 1 high lift pumps also feed the High Street Tank, which varies between 1.5 m and 7.0 m. The pressure in Zone 1 at the pumphouse is not allowed to exceed 655 KPa (95 psi).

The Zone 2 high lift pumping units provide water to the distribution system as well as fill the Tower Hill Reservoir, which is maintained at a level of between 3.7 and 5.2 m water depth.

(c) Filter Backwashing

The main criteria for initiating backwash procedures at the Peterborough plant is headloss. A filter is backwashed when the headloss through the filter is 1.83 m (6 ft.) The filters do not have individual effluent turbidimeters; therefore, turbidity breakthrough is not used as a criteria for backwashing a specific filter. A copy of the backwashing procedure for the Peterborough plant is included in Appendix B.

Filters 1 and 2 in Plant 2 appear to filter more water between backwashes than Filters 1-9 in Plant 1. This is discussed further in Section E.3(d). A filter may be backwashed before a 1.83 m head loss is experienced, especially during the summer months when the water demand is higher. The operators will backwash a filter earlier than required to ensure sufficient water is produced during the peak times of the day. During these peak demand times, a filter should not be taken out of service for backwashing, and the filter needs to be clean to produce water at a high rate.

The filter runs can be as short as 12 hours with poor summer conditions, or as long as 10 days or more with good winter conditions.

(c) Filter Backwashing (cont'd)

For Plant 1, Filters 7-9, the low and high backwash rates of 17 and 31 m/h provide a bed expansion of approximately 0% and 14%, respectively, at 15°C. As noted earlier, the volume of water used during a backwash is 4.1 to 4.6 m^3/m^2. Previous experience indicates that a wash volume of 4.0 to 5.0 m^3/m^2 should adequately clean a filter bed, and the wash volumes for Plant 1 fall within this range.

For Plant 2, the low and high backwash rates of 10 and 26 m/h provide a bed expansion of approximately 0% and 9%, respectively, at 15°C. Consideration should be given to providing higher backwash rates. The wash volumes used in Plant 2 are somewhat higher than Plant 1, ranging from 5.4 to 6.8 m^3/m^2. These wash volumes exceed the range of 4.0 to 5.0 m^3/m^2.

The backwash procedure should be investigated to determine the relative durations of the low and high wash rates so as to minimize the resultant backwash water volume. The backwash must continue to maintain the long term cleaning of the filters.

(d) Chemical Dosage Control

There are three chemical application points in the Peterborough Water Filtration Plant: one in the low lift suction well, one in the raw water header, and one at the treated water junction chamber (common point).

Chlorine is added in the low lift suction well. The coagulant is added in the raw water header. Chlorine or sulphur dioxide, and fluoride is added at the junction chamber.

CHLORINE

Pre-chlorine is added to obtain a specific free residual in the settled water. The value of this desired free chlorine residual is dependent upon the temperature and pH of the raw water and whether a coagulant is being used. The Peterborough plant strives to achieve the following free chlorine residuals in the settled water:

Raw Water Condition	Desired Settled Water Free Chlorine Residual (mg/L)
Extremely cold water (2°C or less) No coagulant added	2.5
Cold water Coagulant added	0.8 - 1.0
Warm water Coagulant added	1.5 - 2.5

The free chlorine residual is continuously analyzed and recorded on a chart.

During the extremely cold and the warm raw water conditions, the process of superchlorination is used. The superchlorination process consists of maintaining a high pre-chlorine free residual, followed by post-residual controlled dechlorination with sulphur dioxide. In Peterborough's case, the higher settled water free chlorine residual is maintained during the extremely cold raw water conditions to ensure complete disinfection, since no coagulant is used at this time. During the warm water conditions, superchlorination is used to ensure disinfection, to control taste and odour problems, and to compensate for the shorter contact times experienced during the summer months due to the increased flow rates.

At all times, a free chlorine residual of some degree persists through the mixing chambers, settling tanks and filters.

Post-chlorine or sulphur dioxide is added to the plant effluent to achieve a total chlorine residual of 1.4 mg/L at all times. A total chlorine residual of 1.4 mg/L is maintained to ensure that a chlorine residual exists in all parts of the distribution system. The plant effluent total chlorine residual is continuously analyzed and recorded on a chart.

COAGULANT

Alum dosages vary between 0 and 43 mg/L, with an average value of 10-20 mg/L when applied; polyaluminum chloride dosages vary between 0 and 19 mg/L, with an average value of 3-10 mg/L when applied.

Raw water quality changes are usually gradual and relatively small; therefore, corresponding coagulant dosage changes are gradual. A turbidity profile, with measurements of raw, settled, filtered, and treated water turbidities, is taken daily. With these records, a change in raw water turbidity and a corresponding change in settled water turbidity can be recognized and dealt with by a change in alum dosage before significant effects are felt by the filters.

Jar tests are conducted when the raw water quality changes and there is a noticeable decrease in the quality of the floc in the plant process. The lab technician conducts the jar testing in the laboratory. The coagulant feed rate is then manually adjusted by the operator.

The Plant Superintendent noted that results obtained by jar tests and the corresponding conditions experienced by the plant were more closely matched by alum jar testing than with polyaluminum chloride jar testing.

During steady raw water conditions, experience and observation of water on top of the filters are used to make dosage adjustments.

The coagulant metering pump has a manual stroke adjustment, and the speed is flow paced by the raw water flow signal. Coagulant usage is determined by measuring the level in the storage tank after each 8 hours of operation. Dosage calculations are usually made on the 24 hour usage. The 24-hour level drop in the storage tank ranges from approximately 7 to 25 cm, depending on the dosage and plant flow rate. The level can be measured within ±0.5 cm, thus for an overall measurement of 7 cm, the accuracy is approximately ±10%. In Gore & Storrie's opinion, this provides a relatively reliable means of determining the daily average coagulant dosage in this case.

FLUORIDE

Fluoride is added to the water using hydrofluosilicic acid. The acid is added by a 0.76 L/min metering pump which is flow paced by the summated treated water flow signal. The addition of fluoride is controlled by a compound loop system which ensures a plant effluent fluoride residual of approximately 1.2 mg/L F^-.

The fluoride residual of the Zone 2 water is continuously analyzed and recorded on a chart. A grab sample of Zone 2 treated water is analyzed for fluoride every day in the laboratory. The lab fluoride analyzer is standardized each day and is used to verify the continuous analyzer readings.

Acid usage is determined by measuring the level in the day tank after each 8 hours of operation. Dosage calculations are usually made on the 24-hour usage.

SULPHUR DIOXIDE

A compound loop control system for sulphur dioxide is used, based on chlorine residual.

Sulphur dioxide is used for dechlorination, when the process of superchlorination is used, to lower the plant effluent total chlorine residual to approximately 1.4 mg/L. Dosages range from 0.3 to 0.6 mg/L.

(e) Quality Control Testing

The following table lists pertinent information on the sampling system in use at the Peterborough plant.

SOURCE	LENGTH/SIZE (m/mm)	FLOW (L/min)		VELOCITY (m/s)		TRAVEL TIME (min)	
		Max.	Norm.	Max.	Norm.	Max.	Norm.
Raw Water (intake pipe)	20/13	7.8	3.68	0.98	0.46	0.34	0.72
Settled Water (settled water conduit)	30/13	12.0	4.24	1.51	0.53	0.33	0.94
Clearwell (Plant 2)	55/13	8.4	2.24	1.06	0.28	0.87	3.26
Plant Effluent (after Zone 2 pumps)	70/13	7.2	4.4	0.90	0.55	1.29	2.11
*Plant Effluent (just downstream of junction chamber)							

* Only used when Zone 2 pumping is down (seldom). Sampling point is too close to the junction chamber; inadequate chemical mixing.

NOTE: All sample lines within the plant are 13 mm diameter PVC pipe, except for the copper and stainless steel raw water sample line. There is a stainless steel treated water sample line at the pumphouse (Zone 1) which is used for DWSP purposes only.

The sample flow rate was determined by a time displacement test; firstly at the normal flow rate, and secondly, at the maximum flow rate with the sample tap wide open.

The sampling lines are run at the maximum flow rate at least once a week to flush the lines and keep them free of sediment.

TURBIDITY

There are two continuous on-line turbidity measurements:

SAMPLE POINT	TESTING INSTRUMENT	CHART LOCATION
Settled Water Conduit	HF Model DRT 1000	Laboratory
Zone 2 High Lift Discharge	Hach 1720B	Control Room

The turbidity readings of the above two instruments are recorded continuously on charts. The lab technician also takes grab samples once a day from the two locations and measures the turbidity with the laboratory HF Model DRT 1000 turbidimeter. These numbers are recorded in the daily log books.

Each day, turbidity standards are used to standardize the HF turbidity meter. The Hach turbidimeter is then calibrated with the HF meter.

In addition to the turbidity measurements listed above, the lab technician also collects a grab sample once a day from the raw water and clearwell sampling lines. These turbidity values are also recorded in the daily log book. There is a good correlation between the Drinking Water Surveillance Program (DWSP) turbidity results and those obtained at the plant. The DWSP raw water turbidities are usually slightly higher than the plant readings, but the plant effluent turbidity values are very similar.

Presently, there are no on-line filter effluent turbidity measurements for individual filters; however, the Peterborough Utilities Commission plans to install filter effluent turbidimeters in the near future.

(e) Quality Control Testing (cont'd)

IN-PLANT MONITORING

The following table provides a list of the tests performed at the plant:

TEST	SAMPLE POINT	TESTING FREQUENCY	REPORTING FREQUENCY	TESTING INSTRUMENT
Cl_2 Residual - Pre-free	Settled water conduit	Continuous	Recorded on chart	W&T A767 Amp. residual analyzer
Pre-free	Settled water conduit	5/week	5/week	Amp. titration
- Post-total	Zone 2 Discharge	Continuous	Recorded on chart	W&T A767 Amp. residual analyzer
Post-total	Zone 2 Discharge	5/week	5/week	Amp. titration
Turbidity	Raw	5/week	5/week	HF Model DRT 1000
	Settled	5/week	5/week	HF Model DRT 1000
	Settled	Continuous	Recorded on chart	HF Model DRT 1000
	Clearwell	5/week	5/week	HF Model DRT 1000
	Zone 2 Discharge	5/week	5/week	HF Model DRT 1000
	Zone 2 Discharge	Continuous	Recorded on chart	Hach 1720B
pH	Raw	5/week	5/week	Orion 501 pH meter
	Settled	5/week	5/week	
	Clearwell	5/week	5/week	
	Zone 2 Discharge	5/week	5/week	
Fluoride	Zone 2 Discharge	Continuous	Recorded on chart	W&T 84-130 electronic fluoride analyzer
	Zone 2 Discharge	5/week	5/week	Orion 407 Ionanalyzer

(e) Quality Control Testing (cont'd)

TEST	SAMPLE POINT	TESTING FREQUENCY	REPORTING FREQUENCY	TESTING INSTRUMENT
Temperature	Raw	5/week	5/week	
	Low Lift Suction well	Continuous	Recorded on chart	In-line probe
	Low Lift Suction well	1/week		
Algae Counting	Raw	1/week	1/week	Whipple cell apparatus
Bacteriological Testing Total and Fecal Coliform (1)	Raw Clearwell Zone 2 Discharge Distribution System	4/week 4/week 4/week 40/week	4/week 4/week 4/week 40/week	Standard Membrane Filtration Apparatus
Bacteriological Testing Standard Plate Count (1)	Raw Clearwell Zone 2 Discharge Distribution System	1/week 1/week 1/week 10/week	1/week 1/week 1/week 10/week	Standard Membrane Filtration Apparatus
Aluminum	Clearwell	1/2 weeks	1/2 weeks	Spectrophotometer
Hardness	Zone 2 Discharge	1/2 months	1/2 months	EDTA Colourimetric Titration
Alkalinity	Zone 2 Discharge	1/2 months	1/2 months	Titration to pH 4.65
Chlorides	Zone 2 Discharge	1/6 months	1/6 months	Colourimetric Titration
Iron	Zone 2 Discharge	1/6 months	1/6 months	Hach Colour Comparator
Taste and Odour	Raw Zone 2 Discharge Distribution System	As required As required As required		TON Apparatus

(1) Tests conducted by provincial health lab in Peterborough.

(e) Quality Control Testing (cont'd)

The Peterborough Utilities Commission strives to maintain a high quality laboratory. The Peterborough Utilities Commission feels they are successful in operating the lab and providing reliable results. The lab equipment and continuous monitoring equipment within the plant is regularly calibrated, and in the past, little correction of this equipment has been required.

D.2 Operation and Process Concerns

(a) Inadequate Coagulant Mixing

The present application point for coagulant is into the raw water discharge headers. Consideration could be given to the installation of a mixing device or in-line blender which would ensure uniform distribution of the coagulant throughout the water.

(b) Filter Flow Control

The present method of filter operation is based on a manual adjustment of flow rate to match the low lift flow rate.

Typically, the performance of a filter is sensitive to variations in flow rate. Variable filtration rates are stressful and can lead to reduced performance in filter operation. Consequently, it may be worthwhile assessing the effluent quality improvements which may result from more constant filtration flow rates.

The number of filters operated at any time is also dictated by the low lift flow rate. Given that the filters have the highest performance at the lowest filtration rates, a policy of operating all filters all of the time should be considered. It should be recognized, however, that there are operational difficulties which arise in operating all filters all the time.

(c) Coagulant Application

During the winter months when the raw water temperature is 2°C or less, the Peterborough plant does not add a coagulant. The process of superchlorination is used during this period to ensure adequate disinfection. Even though the raw water turbidity is very low at this time, the plant may not be able to withstand a challenge by Giardia or similar cysts without alum or some other coagulant. The current practice of not adding alum during the extremely cold water conditions should be reviewed.

(d) Wash Water Rate

As discussed earlier, the low "high backwash" rates may not provide sufficient bed expansion. The condition should be reviewed in detail.

The wash volumes used in Plant 2 range from 5.4 to 6.8 m^3/m^2. Experience indicates that a wash volume of 4.0 to 5.0 m^3/m^2 should properly clean a filter bed. The existing backwash procedure, the backwash rates, and the filter operation should be investigated to optimize the backwash procedure and maintain the long-term cleaning of the filters.

(e) Taste and Odour

Taste and odours occur with some regularity each year. Chlorinous odours due to high chlorine dosage and algae odours occur during the spring and summer months.

(f) Powdered Activated Carbon

The storage and feed area is in the workshop. The feed system capacity is capable of 180 kg/d or 3.6 mg/L at a plant flow of 50 ML/d. The powdered activated carbon is used to combat taste and odour events, although in recent years these problems have been minimal and the equipment has not been used since the early 1980's.

(f) Powdered Activated Carbon (cont'd)

When carbon is used, some carbon is bound in the floc and is carried into the filters. At the relatively low PAC dosages in use to date, this carry over of carbon into the filters has not posed an operating problem. It is felt, however, that the carbon carry over might pose a problem if the carbon dosage is significantly increased.

(g) Aluminum Residual

As shown in Appendix A, Table 7.0, there are elevated aluminum residuals. A balance is maintained between high turbidity removals and low aluminum residuals. The topic of aluminum solubility and residual is discussed in detail in the following section (see page 55).

(h) Raw Water Saturated with Air

Due to a number of dams upstream of the water plant, the raw water is always saturated with air, regardless of temperature.

As the temperature of the air and water change, air binding occurs (particularly in the spring and fall). Air binding causes the head loss in the filters to build up rapidly.

(i) Corrosion Potential

The corrosion potential, or Langelier Saturation Index, provides an indication of the aggressivenes of the water. If the index is positive, the water is supersaturated and has a tendency to deposit calcium carbonate scale in the distribution system. If the index is negative, the water is undersaturated and corrosive.

The Saturation Indices reported as part of the DWSP program indicate that the Peterborough raw water has a slightly positive value, while the treated water is slightly negative. In light of the increasing attention on corrosion and the leaching of metals from piping and plumbing materials, it is desirable to produce a treated water with a slightly positive saturation index.

SECTION E

PLANT PERFORMANCE (PARTICULATE REMOVAL)

SECTION E
PLANT PERFORMANCE (PARTICULATE REMOVAL)

E.1 Turbidity Removal

(a) General

The Peterborough plant must deal with the following raw water quality conditions:

Turbidity (FTU)	0.2 - 1.25
Colour (TCU)	10 - 30
pH	7.4 - 8.3
Alkalinity (mg/L)	74 - 80
Hardness (mg/L)	84 - 100
Iron (mg/L)	0.02 - 0.072
Manganese (mg/L)	0.012 - 0.014
Aluminum (mg/L)	0.008 - 0.069
Temperature (°C)	0.3 - 25

The raw water quality is good and is quite consistent all year round. Considering turbidity alone, the raw water conditions would allow treatment by direct filtration (that is, a plant without settling tanks) to meet today's treated water turbidity objective. The Peterborough plant, however, also experiences elevated raw water colour. The settling tanks are required to collect the colour floc which develops from the addition of alum.

The raw water turbidities experienced by the plant over the past several years are summarized in the table on the following page. A graph included in Appendix C as Figure 1.0 shows a Composite Profile of Raw Water Turbidity Ranges for the 1984-1986 period.

1984 - 1986	RAW TURBIDITY (FTU)		
	Max.	Min.	Avg.
January	0.40	0.29	0.33
February	0.36	0.22	0.29
March	0.53	0.24	0.33
April	0.63	0.27	0.41
May	0.82	0.27	0.50
June	0.78	0.30	0.47
July	0.98	0.29	0.57
August	0.99	0.33	0.60
September	1.10	0.34	0.66
October	1.25	0.53	0.74
November	0.86	0.40	0.55
December	0.83	0.35	0.46

(b) Plant Performance

OVERALL PLANT PERFORMANCE

It is usual to consider two conditions for plant operation, the maximum hydraulic flow rate (100 ML/d), and the maximum process flow rate. The maximum process condition, from the standpoint of particulate removal, occurs with the highest solids loading on the plant. At the Peterborough plant, the raw water is quite consistent all year round, although slightly lower turbidity and colour values may be experienced during the winter months (January - March). The maximum solids generated within the process occurs when a coagulant is added (when raw water >2°C). The maximum solids loading on the plant and the maximum flow are coincident at this plant and occur during the summer months.

The plant records for the treated water during the 1984-1986 period are summarized on the following page.

1984 - 1986	TREATED TURBIDITY (FTU)		
	Max.	Min.	Avg.
January	0.37	0.24	0.29
February	0.31	0.24	0.26
March	0.39	0.20	0.26
April	0.43	0.19	0.28
May	0.40	0.20	0.30
June	0.48	0.19	0.28
July	0.41	0.20	0.28
August	0.44	0.21	0.27
September	0.48	0.20	0.30
October	0.51	0.21	0.32
November	0.40	0.12	0.31
December	0.53	0.22	0.37

The records confirm that the plant has consistently produced water of <1.0 FTU. A graph included in Appendix C as Figure 2.0 shows a Composite Performance Profile of Treated Water Turbidity Ranges for the period 1984 - 1986.

ASSESSMENT OF OVERALL PERFORMANCE

The turbidity guideline in the Province of Ontario is 1.0 FTU; but clearly it is important to reduce the turbidity to as low a level as practical.

The historic records of the plant have been reviewed as a means to assess plant performance under various operating conditions.

The plant records show that the plant works very well from the standpoint of turbidity removal. The plant, however, should improve its colour removal capability.

E.2 Treatability Testing

(a) Jar Testing

TURBIDITY REMOVAL

Treatability testing was carried out on a raw water sample collected on 1 April 1987. This raw water sample had a turbidity of 1.2 NTU. The laboratory and treatability results sheets are included in Appendix D.

Alum or polyaluminum chloride was used in separate coagulation/flocculation/ sedimentation testing, followed by filtration through a 1.2 µm membrane filter, which, in our experience, emulates the performance of a dual media filter. The results of the testing demonstrate that filtration down to a turbidity of 0.2 NTU or less is achievable with the appropriate alum or polyaluminum chloride dosage. The alum treatment removed the colour better than the polyaluminum chloride treatment. Both coagulants reduced the turbidity to acceptable values.

ALUMINUM RESIDUAL

The use of aluminum salt coagulants (alum, polyaluminum chloride, etc.) in potable water treatment plants may lead to increased aluminum concentrations in treated water, which may result in water quality and supply problems.

There is no evidence that aluminum is physiologically harmful, and no health-related limit has been specified anywhere in the world to our knowledge. However, the perception of potential health problems associated with aluminum frequently emerges.

Water supply problems may be associated with increased aluminum concentrations in treated water. These problems include the formation of a hydrous aluminum precipitate in the distribution system which may increase turbidity and complaints about clarity. Aluminum floc in the system may interfere with the disinfection process by entrapping and protecting microorganisms. Another problem attributed to increased aluminum concentrations is deposition of aluminum hydrolysis products on pipe walls, which decreases carrying capacity. To minimize these problems, the Ontario Drinking Water Objectives (ODWO) suggest an operational guideline of <0.1 mg/L as Al in the treated water leaving the plant.

An EPA survey of 186 utilities showed that a number of plants exhibited high residual aluminum when overdosing of alum occurred. Even though some utilities surveyed stated that minimizing the alum dosage is a strategy for controlling residual aluminum, underdosing of alum appears to be just as detrimental to turbidity removal and residual aluminum control as overdosing.

Water quality problems associated with high concentrations of aluminum in finished water have led to discussion of ways to reduce residual aluminum concentrations. One method of reducing aluminum concentration is to optimize coagulation. To have optimum coagulation requires that the best coagulant, dosage, and combination of operating conditions be selected for each raw water. The optimum pH range must also be achieved since aluminum is least soluble in water in the pH range 5.5-7.0.

There are treatment plants in Ontario which are currently using residual aluminum as an "operational tool" to optimize the dosage of alum. Operational staff respond to any elevation in residual aluminum and make the necessary adjustments to the plant operation.

Aluminum solubility in water is a complex topic; but some of the most significant variables are pH, time and temperature. For pH values greater than 6.5, the aluminum residual increases directly with pH. Aluminum residual is inversely proportional to time, up to several hours, whereupon the solubility concentration remains fairly constant. The aluminum residual is directly related to temperature, but this has a fairly minor impact over the ranges encountered in natural waters. For times greater than an hour and pH's greater than about 7.4, water may contain a residual concentration greater than 0.1 mg/L.

For the aluminum residuals and pH values found in the waters at the plant, the results are consistent with general experimentally determined values. Therefore, it is not surprising to find aluminum concentrations greater than 0.1 mg/L.

The Peterborough treated water aluminum residuals have occasionally been above the guideline of 0.1 mg/L, therefore, jar tests were run to check the aluminum residual. In Gore & Storrie's opinion, the benefits associated with changing the alum dosage to control the aluminum residual, over and above those for turbidity control, is not warranted.

A minimum of daily monitoring of aluminum residual and pH leaving the plant is recommended by the Ontario Ministry of the Environment. An acceptable method of aluminum analysis should be used. Frequent examination of this data and Drinking Water Surveillance Program (DWSP) data will supply the needed information on the chemistry and fate of aluminum following water treatment to help operating authorities minimize the concentration of aluminum in the treated water.

COAGULANT(S) DOSAGE

From the test work conducted by Gore & Storrie Limited, we believe that the optimum filter effluent quality is achieved with an alum dosage of about 15-25 mg/L or a polyaluminum chloride dosage of about 3-5 mg/L for the raw water conditions experienced by the plant. The polyaluminum chlorine does not remove the colour as well as treatment with alum.

(b) Streaming Current Monitor

During periods of changing raw water quality, a streaming current monitor (SCM) may allow both a faster response and the selection of the correct coagulant dosages.

Milton Roy tested a SCM for one week in the Peterborough Plant. The results of the testing period are not conclusive, but it is believed that a SCM could be a beneficial tool. The coagulation/flocculation process should be optimized before a SCM is considered further.

E.3 Optimum Removal Strategies

(a) Coagulant Addition

As mentioned earlier, there are regular periods during each year when a coagulant is not added to the water. In the past, there has been a tendency in the water treatment industry to stop using alum during periods of low raw water turbidity. This practice does not allow the plant process components to effectively remove turbidity-causing particulate material, and does not ensure removal of certain microorganisms such as Giardia cysts.

A coagulant should be added all of the time to ensure an effective treatment process and to conform with the Ministry of the Environment Policy No. 15-14 (Section 4), "Treatment Requirements for Municipal and Communal Water Works Using Surface Water Sources".

(b) Chemical Mixing

As mentioned earlier, the coagulant is added into the raw water discharge headers. This application point may not provide adequate mixing, especially at lower flow rates. Tests should be conducted to determine the relative merits of blending and flash mixing. This is discussed in more detail in Section G.2.

The Peterborough Utilities Commission staff feel that more flexibility is required for the addition of coagulant and coagulant aids.

(c) Coagulation, Flocculation, and Sedimentation

All of the flocculation and sedimentation tanks are used all of the time, except when being cleaned. There exists a concern about the coagulation/flocculation process, especially during the cold water periods. Since the level of mixing in the flocculation tanks is dictated by the flow rate, there may be some benefits obtained from isolating the pretreatment sections of the plant. The resident time afforded by having all tanks operational is increased at lower flows; thus the mixing system tends to compensate for the reduced flow rates. In addition, the settling tank performance is inversely dependent on the flow rate; therefore, this unit operation tends to also compensate for reduced mixing levels at lower flow rates by becoming more efficient. Since isolation of flocculation tanks also isolates the associated settling tanks, the improved mixing would probably be best overall. However, there are bounds to how low the flow rate can be before overall performance is affected.

It is Gore & Storrie's opinion that there is merit to investigating, on a plant scale, the magnitude of improvement which would result from maintaining high flows in the flocculation tanks. From an operational stand point, however, we believe that the performance improvements may only be small and not worth the efforts of opening and closing valves to suit the changing flows. Therefore, the most benefit may arise from a better understanding of the plant unit operations.

If the coagulation/flocculation process does not produce the required floc during the winter months, it is our opinion that there is merit to investigating, on a plant scale, the improvement which would result from adding a polymer or activated silica immediately following the alum addition.

(d) Filtration

As indicated in Section C.2(i), the average amount of water filtered per cycle is reported as follows:

PLANT	FILTER	AVERAGE FILTERED WATER/CYCLE (m^3/m^2)
1	1-4	30-60
1	5-9	50-115
2	1-2	125-240

Although these are estimates based on the experience of the plant staff, not confirmed by tests, there appears to be a significant difference in the performance of the filters.

The filter cycle performance is dictated by unit flow rate (m/h), influent solids concentration, initial (clean bed) headloss, total headloss, type of underdrains, and the type and depths of media.

The above filter performance factors have been considered and there is no readily apparent explanation for the differences in performance. Consequently, a further detailed investigation should be conducted to evaluate the relative performance of the filters.

(d) Filtration (cont'd)

The number of filters and the filtration rates are presently dictated by the demand for clearwell water. This procedure is stressful for the filters since any change of flow rate can reduce filter removal performance. Also, the lower the filtration rate, the better the removal performance; this can be achieved by operating all filters all the time. Therefore, from the standpoint of particulate removal, the ideal procedure would be to operate all filters with a constant flow rate to satisfy some long-term demand. This procedure requires that the clearwell level rise and fall to offset the difference between production and demand flow rates.

It is Gore & Storrie's opinion that tests should be carried out on plant scale to determine the magnitude of improvement which would result from maintaining lower constant flow rates. These results should be assessed in light of the operational considerations.

In order to optimize the performance of the plant, flow through turbidimeters should be installed on the effluent of the filters. The Peterborough Utilities Commission is planning to implement this.

SECTION F

PLANT PERFORMANCE (DISINFECTION)

SECTION F
PLANT PERFORMANCE (DISINFECTION)

F.1 Disinfection

At the Peterborough Water Treatment Plant, disinfection is practiced by chlorination at the low lift suction well to achieve the settled water free residuals specified in Section D, part (d), Chemical Dosage Control. Data shown in Table 3.0 in Appendix A show that the total monthly average chlorine dosage required to achieve these settled water free residuals ranges from 3.0 to 5.0 mg/L.

During extremely cold water (<2°C) or warm water conditions, the process of superchlorination is used. At these times, sulphur dioxide is applied subsequently at the clearwell to dechlorinate. At other times, post-chlorination is used to achieve the required chlorine residual. The total chlorine residual leaving the plant is 1.4 mg/L, independent of the chlorination process.

F.2 Disinfection Efficiency

Tables 6.0 and 6.1 in Appendix A summarize the available raw and treated microbiological data for the Peterborough plant.

Fecal coliforms, as well as total coliforms, were found in the raw water indicating that disinfection is necessary.

The data show that the microbiological quality of the treated water leaving the plant is good.

F.3 Chlorinated By-Products

TRIHALOMETHANES

Trihalomethanes (THM's) are the most widely occurring organics found in drinking water, and they also appear at the highest concentrations. The principal source of THM's in drinking water is the chemical interaction of chlorine added for disinfection, with humic and fulvic substances that occur naturally in the raw water. There is some evidence that THM's are carcinogenic. The Ontario Drinking Water Objectives for THM's is 350 µg/L.

Based on the data available on THM's (see Table F.1) for the Peterborough Water Treatment Plant, the levels of THM's found in treated water are under the Ontario Drinking Water Objectives of 350 µg/L (0.35 mg/L). Total THM values were determined by the direct aqueous injection method (except for the December 1986 results) which, for the treated water, ranged from 35 to 284 µg/L, with an average value of 132 µg/L. These levels should be reduced, if possible.

In theory, the levels of THM's currently produced at the plant could be lowered by delaying chlorination to after settling, and/or by reducing the chlorine dosages used. The first of these is not practical at this time, as the only common junction point after the settling tanks is the present sulphur dioxide application point. The second alternative, reducing chlorine dosages, should be delayed until coagulation/flocculation/settling is improved and coagulant is applied throughout the year.

TOTAL ORGANIC HALIDES

The terms of reference require consideration be given to the reduction of chlorinated by-products in the treated water. There was no complete set of information on the total concentrations of all organohalogen compounds.

F.3 Chlorinated By-Products (cont'd)

It is Gore & Storrie's opinion that a broader measurement of chlorinated by-products and other organic contaminants should be considered and possibly a surrogate measurement should be utilized. Although there is not general agreement in the field which surrogate measurement should be used, the measurement should report the sum of all the organic halogen compounds.

TABLE F.1

Trihalomethane Data for Peterborough WTP

		1983		1984		1985		1986	
		R	T	R	T	R	T	R	T
JAN	Total THM's	ND	108	ND	-	ND	108	ND	165
FEB		ND	140	ND	86	ND	102	ND	142
MAR		-	-	ND	108	ND	108	ND	121
APR		ND	100	ND	92	ND	96	ND	179
MAY		ND	108	ND	130	ND	113	ND	194
JUN		ND	138	ND	110	ND	132	-	208
JUL		ND	155	-	76	ND	163	-	-
AUG		ND	137	ND	136	ND	168	ND	167
SEP		ND	91	ND	171	ND	191	-	-
OCT		ND	120	ND	181	-	136	ND	284
NOV		ND	106	ND	111	ND	101	ND	165
DEC			-	1	103	ND	35	ND	86
AVG.		ND	120	ND	119	ND	121	ND	171
RNG.			91-155	ND-1	86-181		35-191		86-284

R = Raw water
T = Treated water (plant effluent)

NOTE: Values obtained by the direct aqueous injection technique, except for December of 1986, which was done by purge and trap.

The treated water data are for samples preserved with sodium thiosulphate. THM analysis results of unpreserved distribution system samples are also available, but for consistency, only the plant effluent sample results are shown in the above table.

SECTION G

SHORT AND LONG-TERM MODIFICATIONS

SECTION G
SHORT AND LONG-TERM MODIFICATIONS

G.1 Description

This section includes feasible short and long-term process modifications required to approach optimum disinfection and particulate removal. It is important to understand that optimization of selected process steps may be in conflict with other aspects of the plant, such as staffing and budgeting costs. Estimated costs for each recommendation are also included.

The following short and long-term recommendations were provided, discussed, reviewed, and agreed upon at the plant site meeting.

We have assigned costs for each of the recommended works. Clearly, these costs may be reduced if the Peterborough Utilities Commission carries out the work.

G.2 Chemical Mixing

There can be two purposes for mixing of chemicals into the main process stream: blending and flash mixing. Blending consists of the distribution of chemicals uniformly throughout the body of the process stream and is characterized by relatively high velocity gradients of greater than 200 sec^{-1} for periods of up to several minutes. Flash mixing addresses the coagulation concept that blending must occur within a very short period of time, a matter of seconds, and this requires very high velocity gradients of greater than 1000 sec^{-1}. It is important to recognize the difference between these two concepts and their process implications. Blending mixing is to ensure that the process components will behave uniformly. Flash mixing has been espoused by some researchers in water chemistry as improving the coagulation process.

There is no flash mixing at the Peterborough plant. The coagulant is added to the raw water header on the discharge side of the low lift pumps.

Uniform blending of the coagulant throughout the water may not occur during low flow rates. Consideration should be given to the installation of a mixer which would ensure uniform distribution of the coagulant throughout the water.

G.2 Chemical Mixing (cont'd)

It is recommended that a series of laboratory and/or pilot tests be conducted to determine the relative merits of blending and flash mixing. Should the tests prove the cost benefit of both or either form of mixing, consideration should be given to installing appropriate units.

This work can be carried out at any time. The cost of the study would be $10,000 to $15,000, and the in-line blenders and flash mixers could cost $50,000 to $60,000 to buy and install.

G.3 Continuous Coagulant Addition

During the winter months when the raw water temperature is 2°C or less, the Peterborough plant does not add a coagulant.

The Ministry of the Environment recommends that a coagulant be added all year round (see page 58).

The Peterborough Utilities Commission presents several arguments to justify their action of not adding a coagulant during the extremely cold raw water period. These factors include:

1. During the very cold raw water period, the turbidity is generally less than 0.5 FTU. With cold water temperatures and low turbidity values, high coagulant dosages are required to produce a floc, and a poor, unsettlable floc usually results.

2. When a coagulant is not added, the plant effluent easily complies with the MOE objective aluminum residual concentration of 0.1 mg/L.

3. During the winter months, the raw water fecal and total coliform counts are very low.

4. The free chlorine residuals maintained during the winter months are sufficient to provide contact time values that are considered to be cysticidal.

G.3 Continuous Coagulant Addition (cont'd)

5. The lack of coagulant addition in the winter prevents the release of large quantities of aluminum into the aquatic environment.

6. The filters do not require backwashing as often, thereby causing less turbidity peaks from the filters.

7. The filter beds can be run at lower filtration rates with less variation when a coagulant is not added.

8. The Peterborough Utilities Commission believes a better quality effluent can be produced during the winter months by superchlorinating, and not adding a coagulant.

G.4 Coagulant and Coagulant Aid

Polyaluminum chloride is the present coagulant used at the Peterborough plant. Alum may be a more effective coagulant, and enhanced coagulation/flocculation performance may result from the use of coagulant aids.

It is recommended that a series of laboratory tests be conducted using alum and polyaluminum chloride for the various raw water conditions to evaluate their relative performance. In conjunction with these tests, a laboratory study should also be conducted to pre-screen various polyelectrolytes available for use as coagulant aids, including activated silica. Should these tests indicate that alternative coagulant arrangements have merit, conduct a plant-scale program for various seasons of the year. These tests should attempt to identify the optimum location and timing for addition of the coagulant and coagulant aid.

This work could be started at any time. The laboratory study would be $5,000 to $10,000, and the plant scale testing would be $10,000 to $15,000. Installation changes are as yet indeterminable, but the capital cost should be $20,000 to $30,000. The operating costs would increase if a coagulant aid is provided.

G.5 Isolation of Flocculation Tanks

Since the level of mixing in the flocculation tanks is proportional to the flow rate, there may be some benefit obtained by shutting off groups of flocculation tanks. Each group of flocculation tanks feeds two settling tanks; therefore, shutting off one group of flocculation tanks also shuts off the associated settling tanks.

It is recommended that the operation of the flocculation tanks at various flow rates be compared.

This plant-scale work should be carried out during the winter, when the overall plant flows are lower. The cost of this recommendation is minimal.

G.6 Filtration Rates

The filtration rates at the Peterborough plant are dictated by the demand for clearwell water. Variable filtration rates are stressful, and can reduce the filters' particulate removal performance. From the standpoint of particulate removal, the ideal procedure would be to operate all of the filters all of the time at a constant rate to satisfy a long-term demand.

It is recommended that plant scale tests on the filters be conducted to determine the magnitude of improvement which would result from maintaining lower constant filter flow rates.

This work could be conducted at any time. The cost of the study would be $10,000 to $15,000.

G.7 Relative Filter Performance

Filter cycle performance is dictated by unit flow rate, influent solids concentration, initial headloss, total headloss, type of underdrains, and the type and depths of media. These filter performance factors have been considered and there is no readily apparent explanation for the differences in performance.

G.7 Relative Filter Performance (cont'd)

It is recommended that a detailed investigation be conducted to evaluate the relative performance of the filters.

This work could be conducted at any time. The cost of the study would be $20,000 to $25,000.

G.8 Filter Effluent Turbidimeters

The use of filter effluent turbidimeters enables monitoring of individual filter effluent quality. An increased filter effluent turbidity can be detected and the filter backwashed before any significant increase in plant effluent is observed.

It is recommended that either individual filter effluent turbidimeters or turbidity monitoring stations be installed to monitor the effluents of the eleven filters.

This work should be conducted as soon as possible. It is understood that the Peterborough Utilities Commission is planning to install filter effluent turbidimeters in the near future. The total cost of eleven individual effluent turbidimeters would be approximately $35,000 to $40,000.

G.9 Filter Cleaning

Our previous experience has shown that a backwash water volume of 4.0 to 5.0 m^3/m^2 of filter area adequately cleans a filter bed. The wash volume at the Peterborough Plant 2 is somewhat higher at 5.4 to 6.8 m^3/m^2. The high backwash rate of 26 m/h only provides a bed expansion of approximately 9%.

It is recommended that the backwash procedure be investigated to determine the relative duration and rise rates of the low and high backwash rates which minimize the wash volume and yet maintain the long-term cleaning of the filter.

This work could be carried out at any time. This recommendation could be conducted by Peterborough Utilities Commission staff.

G.10 Filter Effluent Flow Metering

All of the eleven filters at the Peterborough plant have separate flow meters. The Ministry of the Environment has recommended that totalizers be installed on each filter to quantify flows. The purpose of the totalizers is to provide a means of verifying flow data so that during an operational upset, the flows and dosages could be confirmed.

The work could be conducted at any time. The cost to buy and install eleven totalizers would be approximately $25,000.

G.11 Trihalomethanes

The total trihalomethane (TTHM) values during the 1983 to 1986 period ranged from 35 to 284 µg/L, with an average value of 132 µg/L. Although these values are below the guideline of 350 µg/L, the TTHM level should be reduced if possible. In theory, the level of THMs could be lowered by delaying chlorination to after settling.

It is recommended that a study be conducted to evaluate the possible methods of THM reduction. The feasibility of implementing THM reduction methods, such as delaying or partially delaying chlorination within the process until many of the THM precursors are removed, should be assessed.

This study could be started immediately and would cost $35,000 to $50,000.

G.12 Chlorinated By-Products

It is Gore & Storrie's opinion that a broader measurement of chlorinated by-products and other organic contaminants should be considered. Although there is not general agreement in the field which surrogate measurement should be used, the measurement should report the sum of all the organic halogen compounds.

It is recommended that the Province of Ontario develop a surrogate measurement for chlorinated by-products and other organic contaminants.

G.13 Record of Information

The nature, frequency, and arrangement of information recorded about plant operations is vital to the operation and management of a water treatment plant. A particularly useful set of operating data is the Turbidity Profile through the plant. These records indicate the effects of changing conditions on specific operations through the process.

It is recommended that the Plant's record of information include a process and piping diagram (PAPD).

APPENDIX A

TABLES

TABLE 1.0: FLOWS (ML/d)

WPOS PETERBOROUGH WTP

MONTH	R/T	1986			1985			1984		
		MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	R	55.09	43.19	49.92	50.60	39.96	45.23	54.87	44.23	49.42
	T	53.51	43.19	49.55	49.78	38.50	44.73	54.87	44.23	48.73
FEB	R	54.55	45.56	50.69	49.28	37.41	45.55	55.55	40.91	47.46
	T	54.55	45.46	50.46	48.87	37.41	45.10	48.19	40.91	42.91
MAR	R	57.28	42.32	50.46	55.23	42.05	47.91	52.92	42.69	47.69
	T	57.28	42.32	50.37	55.23	41.41	46.69	50.73	42.37	47.00
APR	R	60.00	40.37	51.82	55.96	42.73	47.96	53.73	39.55	47.14
	T	55.46	40.37	50.46	52.55	40.73	46.41	51.60	38.64	45.46
MAY	R	75.87	43.46	55.37	57.69	42.60	51.00	54.42	41.82	48.23
	T	74.14	42.05	50.69	54.14	40.78	48.23	50.42	38.19	44.91
JUN	R	68.37	46.41	55.64	72.42	43.37	56.05	81.83	47.51	63.69
	T	65.83	44.46	53.28	67.92	40.73	52.78	75.55	44.51	59.96
JUL	R	85.46	42.68	66.42	86.37	47.10	68.96	93.30	46.00	60.28
	T	(82.24)	41.82	63.05	(80.60)	44.82	64.64	(86.90)	44.23	57.28
AUG	R	64.46	39.73	51.69	84.28	44.87	61.46	63.69	45.42	54.87
	T	62.05	38.73	50.28	79.24	43.73	57.64	59.64	41.91	51.73
SEP	R	54.50	41.10	49.10	63.00	46.91	54.37	56.14	43.78	51.14
	T	54.50	39.14	47.87	58.83	45.23	51.41	52.19	41.78	47.23
OCT	R	54.50	41.00	47.51	57.33	45.28	51.77	54.14	43.00	49.73
	T	52.46	39.32	45.46	55.28	43.19	49.59	50.28	39.82	46.19
NOV	R	51.55	40.91	46.59	55.87	38.69	49.05	53.42	43.41	47.73
	T	49.82	38.73	44.73	54.92	36.82	47.60	48.41	40.41	45.00
DEC	R	53.10	38.73	44.55	51.60	36.19	44.78	61.37	37.05	44.10
	T	50.69	38.05	43.82	50.64	36.19	43.91	57.37	36.69	42.69

NOTE: Max./Min. not necessarily on the same day. Brackets indicate year maximum.

R = Raw; T = Treated

TABLE 1.1: PER CAPITA CONSUMPTION
(L/D/Capita)

CONSUMPTION	1986	1985	1984
Population (1)	61,300	61,300	61,000
Maximum Day	1342	1315	1425
Minimum Day	621	590	601
Average Day	816	814	791
Ratio MD:AD	1.64	1.62	1.80

(1) = Populations supplied by Plant Superintendant
MD:AD = Maximum Day/Average Day

TABLE 20. PARTICULATE REMOVAL SUMMARY

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	Turbidity (FTU)		R	0.38	0.29	0.32	0.40	0.33	0.36	0.39	0.30	0.36			
			T	0.31	0.24	0.27	0.32	0.27	0.29	0.37	0.25	0.32			
	Colour (TCU)		R	20	10	17	17.5	15.0	15.5	15.0	12.5	13.8			
			T	10	5	6	12.5	10.0	10.5	10.0	7.5	9.4			
	Alum	(mg/L)		35.8(1)	35.0	35.4	0	0	0	0	0	0			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R												
			T												
	pH		R	8.3	7.5	8.1	8.3	8.0	8.05	7.9	7.8	7.9			
			T	8.2	7.5	7.7	7.6	7.4	7.49	7.5	7.3	7.3			
	Temperature	(°C)		0.3	0.3	0.3	0.6	0.6	0.6						
FEB	Turbidity (FTU)		R	0.30	0.24	0.27	0.36	0.29	0.32	0.36	0.22	0.29			
			T	0.28	0.20	0.24	0.31	0.24	0.27						
	Colour (TCU)		R	20	20	20	20	15	19	20	15	17.5			
			T	10	5	8	15	10	11.0	10	10	10			
	Alum	(mg/L)		0	0	0	0	0	0	0	0	0			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R												
			T												
	pH		R	8.2	8.2	8.2	8.0	7.9	8.0	7.9	7.8	7.9			
			T	7.7	7.6	7.65	7.5	7.4	7.48	7.5	7.3	7.34			
	Temperature	(°C)		0.3	0.3	0.3	0.6	0.6	0.6						

R = Raw; T = Treated

(1) = Alum January 10 - 11, no coagulant other days.

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
MAR	Turbidity (FTU)		R	0.34	0.24	0.26	0.53	0.35	0.38	0.36	0.29	0.34			
			T	0.26	0.20	0.22	0.39	0.21	0.27	0.35	0.28	0.29			
	Colour (TCU)		R	20	15	18.7	30	20	23.7	20	15	17.5			
			T	10	10	10	15	10	11	10	10	10			
	Alum	(mg/L)		0	0	0	31.4(2)	9.6	23.64	0	0	0			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R						0.023			0.011			
			T						0.022			0.008			
	pH		R	8.0	8.0	8.0	8.0	7.9	7.94	8.0	8.0	8.0			
			T	7.5	7.4	7.5	7.6	7.1	7.3	7.5	7.4	7.5			
	Temperature	(°C)		--	--	--	2	0.6	0.8	--	--	--			
APR	Turbidity (FTU)		R	0.30	0.27	0.28	0.60	0.43	0.53	0.63	0.32	0.42			
			T	0.25	0.19	0.22	0.43	0.22	0.31	0.36	0.27	0.31			
	Colour (TCU)		R	30	5	17	30.0	20.0	23.3						
			T	15	1	8.3	12.5	7.5	10.0						
	Alum	(mg/L)					32.0(4)	6.3	24.07	0	0	0			
	PACl	(mg/L)		19.1(3)	1.3	7.58									
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	Metal Res. Al	(mg/L)	R									0.018			
			T									0.005			
	pH		R	8.2	8.2	8.2	8.1	7.9	7.98						
			T	7.7	7.5	7.6	7.6	7.2	7.3						
	Temperature	(°C)		14.5	2.3	7.8	10.0	2.0	5.05						

R = Raw; T = Treated

(2) = Alum March 14 - 22, 25 - 31, no coagulant other days.

(3) = PACl April 8 - 30, no coagulant other days.

(4) = Alum April 1 - 11, 23 - 27, 29, 30, no coagulant other days.

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.0 (cont'd)

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
MAY	Turbidity (FTU)		R	0.38	0.27	0.32	0.53	0.41	0.47	0.82	0.47	0.70			
			T	0.24	0.20	0.22	0.27	0.20	0.24	0.44	0.26	0.40			
	Colour (TCU)		R	30	20	25	20	15	20	20	15	17			
			T	10	10	10	15	10	10	10	5	8			
	Alum	(mg/L)		12.9	1.5	3.95	34.9	17.6	24.93	21.7(5)	12.0	17.21			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R												
			T			0.263									
	pH		R	8.3	8.1	8.2	8.2	8.1	8.1	8.4	8.1	8.2			
			T	7.6	7.5	7.5	7.2	7.0	7.1	7.2	6.9	7.0			
	Temperature	(^{o}C)		20	10	15.4	18	12	14.9	15	15	15			
JUN	Turbidity (FTU)		R	0.38	0.30	0.33	0.57	0.46	0.49	0.78	0.48	0.60			
			T	0.23	0.19	0.21	0.37	0.22	0.26	0.48	0.25	0.36			
	Colour (TCU)		R	20	15	19	20	20	20	20	15	17			
			T	10	5	8	15	10	12	20	5	10			
	Alum	(mg/L)		24.3	8.5	17.92	20.0	10.4	16.06	17.5	2.5	11.19			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R												
			T	0.25	0.11	0.177									
	pH		R	8.3	8.1	8.2	8.2	8.1	8.1	8.3	8.0	8.1			
			T	7.3	7.1	7.2	7.4	6.9	7.1	7.4	7.0	7.2			
	Temperature	(^{o}C)		20.8	17.7	18.9	21.0	15.5	18.3						

R = Raw; T = Treated

(5) = Alum May 1, 2, 22 - 31, no coagulant other days.

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JUL	Turbidity (FTU)		R	0.36	0.29	0.33	0.98	0.52	0.64	0.80	0.69	0.75			
			T	0.33	0.20	0.23	0.32	0.22	0.27	0.41	0.26	0.35			
	Colour (TCU)		R	30	20	22	30.0	20.0	24.6	25.0	17.5	19.4			
			T	15	5	11.0	12.5	10.0	11.8	17.5	10.0	14.1			
	Alum (6a)	(mg/L)		22.0	12.6	18.0	20.5	8.8	12.74	15.4	1.9	7.21			
	PACl (6b)	(mg/L)		11.3	3.4	6.6									
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	Metal Res. Al	(mg/L)	R												
			T	0.21	0.19	0.203									
	pH		R	8.2	8.1	8.12	8.2	8.1	8.15	8.0	7.4	7.7			
			T	7.5	7.0	7.3	7.2	7.0	7.1	7.3	7.0	7.2			
	Temperature	(°C)		25.2	20.9	23.4	23.5	20.5	22.5						
AUG	Turbidity (FTU)		R	0.39	0.33	0.35	0.79	0.57	0.65	0.99	0.69	0.80			
			T	0.26	0.21	0.23	0.39	0.24	0.27	0.44	0.28	0.32			
	Colour (TCU)		R	25	20	24	25	20	23	20	13	18			
			T	10	8	9	13	10	12	13	10	11			
	Alum	(mg/L)		7.5	0.5	3.18	17.1	7.8	12.63	10.0	2.5	7.4			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R						0.008			0.03			
			T	0.20	0.18	0.19			0.360			0.270			
	pH		R	8.2	8.1	8.2	8.3	8.1	8.2	8.5	7.7	7.9			
			T	7.5	7.2	7.4	7.2	7.0	7.1	7.7	7.1	7.3			
	Temperature	(°C)		23.4	18.5	22.0	23.5	19.0	21.3	--	--	--			

R = Raw; T = Treated
(6a) = Alum July 1 - 16 1986
(6b) = PACl July 17 - 31 1986

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.0 (cont'd.)

MONTH	PARAMETER		1986			1985			1984					
			MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
SEP	Turbidity (FTU)	R	0.42	0.34	0.37	1.10	0.64	0.79	0.95	0.72	0.82			
		T	0.26	0.20	0.23	0.48	0.26	0.32	0.46	0.30	0.35			
	Colour (TCU)	R	25	20	24			25(7)	25	25	25			
		T	10	5	8			10(7)	15	15	15			
	Alum (mg/L)					17.3	4.1	14.6	8.7	3.3	7.1			
	PACl (mg/L)		7.2(8)	0.4	2.7									
	Coagulant Aid (mg/L)													
	(1) (mg/L)													
	(2) (mg/L)													
	(3) (mg/L)													
	Metal Res. Al (mg/L)	R												
		T			0.16									
	pH	R	8.3	8.2	8.2	8.3	8.2	8.3	8.5	8.3	8.4			
		T	7.6	7.3	7.5	7.4	7.1	7.2	7.4	7.3	7.4			
	Temperature (°C)		20.7	15.1	17.0	20.5	17.3	19.1	--	--	--			
OCT	Turbidity (FTU)	R	1.25	0.77	1.02	0.73	0.54	0.62	0.65	0.53	0.59			
		T	0.51	0.21	0.34	0.40	0.23	0.29	0.36	0.30	0.33			
	Colour (TCU)	R	30	20	26	25	20	24	20.0	15.0	17.5			
		T	10	5	8.1	10	10	10	12.5	7.5	10.8			
	Alum (mg/L)					27.6	7.3	16.7	10.5	0.5	7.8			
	PACl (mg/L)		10.2(9)	1.9	6.7									
	Coagulant Aid (mg/L)													
	(1) (mg/L)													
	(2) (mg/L)													
	(3) (mg/L)													
	Metal Res. Al (mg/L)	R												
		T												
	pH	R	8.2	8.1	8.2	8.3	8.1	8.2	8.2	8.1	8.2			
		T	7.6	7.4	7.5	7.2	6.8	7.1	7.2	7.1	7.2			
	Temperature (°C)		16.2	9	11.43	17.3	11.7	13.8	13	13	13			

R = Raw; T = Treated

(7) = Only one value available, no coagulant other days.

(8) = PACl September 2 - 26, 30, no coagulant other days.

(9) = PACl October 1 - 12, 16 - 31, no coagulant other days.

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
NOV	Turbidity (FTU)		R	0.86	0.50	0.66	0.54	0.44	0.49	0.60	0.40	0.49			
			T	0.40	0.12	0.30	0.35	0.26	0.31	0.38	0.24	0.33			
	Colour (TCU)		R	30	15	21	30	20	26	20	15	18			
			T	10	5	8	20	10	11	15	10	13			
	Alum	(mg/L)					23.9	5.1	15.1	40.0	5.1	14.0			
	PACl	(mg/L)		12.2(10)	6.2	9.1									
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	Metal Res. Al	(mg/L)	R						0.026			0.016			
			T	0.35	0.20	0.276			0.340			0.530			
	pH		R	8.4	8.2	8.3	8.3	8.2	8.2	8.4	8.1	8.3			
			T	7.7	7.4	7.6	7.6	7.1	7.3	7.4	7.1	7.2			
	Temperature	(°C)		7.2	2.2	4.4	9.0	3.0	5.6	11.2	3.0	4.6			
DEC	Turbidity (FTU)		R	0.59	0.36	0.50	0.83	0.39	0.48	0.47	0.35	0.39			
			T	0.35	0.22	0.28	0.53	0.25	0.53	0.40	0.24	0.29			
	Colour (TCU)		R	20	15	20	20	20	20	20	10	16			
			T	10	5	7	15	10	12	15	10	11			
	Alum	(mg/L)					43.0	1.4	28.6	34.3	3.4	19.1			
	PACl	(mg/L)		14.4(11)	3.5	10.5									
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	Metal Res. Al	(mg/L)	R												
			T			0.280									
	pH		R	8.4	8.2	8.26	8.3	8.2	8.2	8.3	8.1	8.2			
			T	7.7	7.6	7.66	7.8	7.1	7.5	7.5	7.0	7.3			
	Temperature	(°C)		0.6	0.3	0.35	1	9	0.45	1.7	0	1.02			

R = Raw; T = Treated

(10) = PACl used for entire month, no coagulant other days.

(11) = PACl December 1 - 12.

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation"(Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.1 PARTICULATE REMOVAL PROFILE (JANUARY 1986)

Page 1 of 2

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							0										
2	0.38	0.40	0.31	0.30			0										0.3
3	0.35	0.36	0.29	0.28	15	5-10	0								8.2	7.5	
4							0										
5							0										
6	0.34	0.34	0.29	0.27			0										
7	0.31	0.31	0.27	0.27			0										
8	0.34	0.34	0.30	0.30			0										
9	0.32	0.34	0.28	0.31			0								8.2	7.6	
10	0.33	0.32	0.28	0.30			35.8										0.3
11							35.0										
12							0										
13	0.32	0.32	0.27	0.27	15	5	0								8.3	7.5	
14	0.32	0.32	0.30	0.31			0										
15	0.33	0.33	0.26	0.27			0										

TABLE 2.1 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AIO	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^oC)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16							0										
17							0										
18							0										
19							0										
20	0.32	0.32	0.3	0.28	20	5	0								8.1	7.5	
21	0.32	0.33	0.29	0.30			0										
22	0.33	0.34	0.27	0.26			0										
23	0.29	0.30	0.25	0.24			0								8.2	7.6	
24	0.30	0.31	0.24	0.25	10-20	5	0										0.3
25							0										
26							0										
27	0.29	0.30	0.26	0.24	20	10-5	0								8.1	7.6	
28	0.29	0.29	0.27	0.27			0										
29	0.30	0.30	0.27	0.26			0										
30	0.29	0.29	0.27	0.27			0								8.2	7.7	
31	0.29	0.29	0.24	0.24			0										

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2 2: PARTICULATE REMOVAL PROFILE (APRIL 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.28	0.29	0.25	0.25			0										2.3
2	0.29	0.29	0.22	0.21			0										
3	0.29	0.30	0.23	0.23	15-20	10-15	0								8.2	7.7	3.5
4	0.30	0.30	0.26	0.25			0										
5							0										
6							0										
7	0.29	0.30	0.24	0.23			0										5
8	0.29	0.30	0.23	0.24			* 11.1										
9							16.3										
10							15.3										
11							16.8										
12							14.0										
13							12.6										
14							14.5										
15							7.6										

* Changed to PACl

TABLE 2.2 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		PACl	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.28	0.25	0.20	0.19			19.1										6.1
17	0.27	0.27	0.21	0.21	20	5-10	7.7								8.2	7.5	
18	0.27	0.30	0.23	0.23	5	1-2	5.5										
19							5.8										
20							4.6										
21	0.28	0.30	0.22	0.23			4.2										10
22	0.27	0.31	0.22	0.22			2.1										7.2
23	0.26	0.30	0.22	0.23			1.6								8.2	7.7	
24							1.3										
25	0.27	0.28	0.22	0.23	20	10	1.5										10
26							1.7										
27							1.5										
28	0.28	0.30	0.23	0.22			1.5										11.7
29	0.27	0.30	0.22	0.22			2.8								8.2	7.5	
30	0.28	0.29	0.20	0.20	20-30	10	5.6										14.5
31																	

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 23 PARTICULATE REMOVAL PROFILE (JULY 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							20										20.9
2	0.36	0.39	0.23	0.23			22							0.21			
3	0.32	0.35	0.21	0.2			19.1								8.1	7.0	
4	0.31	0.32	0.21	0.20			20.6										
5							21.0										
6							20.0										
7	0.30	0.32	0.22	0.21			17.2								8.2	7.1	23.4
8	0.29	0.32	0.23	0.33			17.2										25
9	0.32	0.32	0.21	0.21			17.9								8.1	7.1	24
10	0.32	0.33	0.22	0.21			16.6										22.4
11	0.31	0.32	0.23	0.22			17.6										
12							16.3										
13							19.1										
14	0.33	0.34	0.24	0.24	20	5-10	16.3								8.1	7.2	21.1
15	0.34	0.36	0.23	0.22			15.6										

TABLE 2.3 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.33	0.38	0.23	0.33			12.6										
* 17	0.32	0.32	0.25	0.25	20	10-15	* 4.7								8.2	7.5	22.9
18	0.36	0.27	0.21	0.21			11.3								8.1	7.3	
19							9.5										
20							8.5										
21							6.3										
22	0.33	0.31	0.20	0.20			6.2								8.1	7.4	24
23	0.31	0.31	0.21	0.20			7.4							0.19			
24	0.31	0.29	0.21	0.21			7.1										25.2
25	0.34	0.32	0.21	0.20			6.6							0.21	8.1	7.4	
26							6.9										
27							6.5										
28	0.32	0.34	0.23	0.22	20-30	15-10	5.4								8.1	7.3	
29	0.33	0.35	0.21	0.20			5.5							0.20			25.2
30	0.34	0.35	0.24	0.23			3.4								8.1	7.3	
31	0.35	0.32	0.22	0.22			4.2										23.5

* Switched to PACl

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.4: PARTICULATE REMOVAL PROFILE (OCTOBER 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		PACl	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/l)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.95	0.62	0.23	0.21			8.6										
2	1.00	0.85	0.30	0.27	25	5-10	7.1								8.1	7.4	
3	1.10	1.15	0.36	0.35			3.1										16.2
4							6.4										
5							7.3										
6	1.35	0.95	0.35	0.29			8.2										
7	1.15	1.10	0.34	0.32			6.9										
8	1.05	0.96	0.29	0.27			5.8										
9	1.21	1.24	0.40	0.40	20-30	5-10	6.4								8.2	7.5	
10	1.25	1.30	0.42	0.43			4.7										12.7
11							5.4										
12							4.0										
13							0										
14	0.96	1.00	0.51	0.51			0										12.3
15	0.98	0.95	0.46	0.47			0								8.2	[illegible]	

TABLE 2.4 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		PACl	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^oC)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	1.15	1.20	0.42	0.44			2.5										
17	1.17	1.45	0.37	0.36	30	10	8.5										10.6
18							8.2										
19							6.8										
20	0.90	1.15	0.31	0.29			8.4										
21							9.9										
22							7.8										
23	0.95	0.91	0.31	0.29			8.7								8.2	7.5	10.6
24	0.90	0.99	0.33	0.31	20-30	5-10	10.2										
25							6.5										
26							6.8										
27	1.18	1.10	0.36	0.35			9.1								8.4	7.6	10
28	0.77	1.21	0.33	0.30			7.8										
29	0.78	0.82	0.33	0.32			1.9										10
30	0.83	0.84	0.40	0.40			3.1										
31	0.80	1.14	0.40	0.38			7.8										9

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation"(Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.5: PARTICULATE REMOVAL PROFILE (JANUARY 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							0										
2	0.40	0.38	0	0.29			0										0.6
3	0.40	0.41	0.31	0.31			0										0.6
4	0.39	0.41	0.32	0.32	15	10	0								8.3	7.6	
5							0										
6							0										
7	0.38	0.37	0.30	0.31			0										0.6
8	0.38	0.37	0.30	0.30	15	10	0								8.1	7.5	0.6
9	0.36	0.36	0.31	0.30			0								8.1	7.5	0.6
10	0.33	0.34	0.29	0.29			0										0.6
11	0.36	0.35	0.31	0.29	15	10	0								8.1	7.5	0.6
12							0										
13							0										
14	0.35	0.35	0.29	0.30			0										0.6
15	0.39	0.35	0.34	0.31	15-20	10-15	0								8.0	7.5	0.6

TABLE 2.5 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^oC)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.37	0.37	0.28	0.27			0								8.0	7.4	0.6
17	0.35	0.34	0.29	0.28			0										0.6
18	0.35	0.34	0.29	0.29			0								8.0	7.4	0.6
19							0										
20							0										
21	0.36	0.36	0.28	0.27	15	10	0								8.0	7.5	
22	0.36	0.34	0.28	0.28			0										0.6
23	0.35	0.36	0.28	0.28			0								8.0	7.5	0.6
24	0.33	0.33	0.27	0.28			0										0.6
25							0										
26							0										
27							0										
28	0.33	0.34	0.28	0.29			0								8.0	7.5	0.6
29	0.34	0.35	0.29	0.28			0										0.6
30	0.34	0.34	0.28	0.28			0								8.0	7.5	0.6
31	0.34	0.33	0.27	0.27			0										0.6

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2 6: PARTICULATE REMOVAL PROFILE (APRIL 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AlO	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.47	0.35	0.25	0.23			24.1										
2	0.46	0.69	0.25	0.25			30.6								7.9	7.2	2.0
3	0.43	0.64	0.22	0.22			29.8										2.0
4	0.43	0.71	0.25	0.24			27.8								7.9	7.2	
5							31.5										
6							32.0										
7							28.3										
8							30.1										
9	0.51	0.73	0.26	0.25			29.4										2.0
10	0.55	0.65	0.22	0.22	20	5-10	26.6								8.0	7.3	
11	0.55	0.65	0.25	0.24			17.9										2.0
12	0.55	0.60	0.38	0.36			0										
13							0										
14							0										
15	0.58	0.59	0.44	0.43			0								8.0	7.6	4.0

TABLE 2.6 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^{o}C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.57	0.56	0.42	0.42			0										
17	0.57	0.62	0.41	0.40			0										4.5
18	0.60	0.59	0.40	0.39	30	10-15	0										
19	0.58	0.57	0.39	0.37			0										
20							0										
21							0										
22	0.59	0.59	0.39	0.39			0										7
23	0.56	0.72	0.33	0.34			18.8										8
24	0.52	0.72	0.25	0.25			29.2										9
25	0.50	0.68	0.29	0.28			29.2										
26							16.9										
27							6.3										
28							0										
29	0.49	0.74	0.32	0.31	20	10	8.4								8.1	7.2	10
30	0.54	0.89	0.30	0.30			16.4										
31																	

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.7. PARTICULATE REMOVAL PROFILE (JULY 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^oC)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							4.9										
2							12.9										
3							11.9										
4	0.60	0.78	0.27	0.26	20	10	11.4										22
5	0.63	0.74	0.27	0.27			9.9										
6							13.5										
7							10.3										
8	0.52	0.67	0.28	0.26			9.8								8.2	7.2	20.5
9	0.53	0.72	0.28	0.27			8.8										22
10	0.55	0.70	0.28	0.27			12.9										22
11	0.52	0.52	0.23	0.22	20-25	10	20.5								8.2	7.0	
12	0.53	0.65	0.26	0.25			17.2								8.1	7.0	22.4
13							12.6										
14							11.4										
15	0.58	0.65	0.29	0.28	20-30	10-15	11.4								8.1	7.1	22.8

TABLE 2.7 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^{o}C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.98	0.96	0.32	0.32			10.5										
17	0.68	0.72	0.29	0.29	20-30	10-15	13.2								8.1	7.1	
18	0.69	0.73	0.28	0.28			16.4										23.3
19							14.5										
20							11.7										
21							12.6										
22	0.55	0.66	0.29	0.28			12.7										23.3
23	0.61	0.78	0.30	0.29	20-30	10-15	12.0								8.2	7.1	22
24	0.59	0.70	0.29	0.27			12.4										
25	0.60	0.73	0.28	0.26			13.9										23.5
26	0.59	0.68	0.28	0.27	20-30	10-15	13.5								8.1	7.1	23.5
27							11.6										
28							12.9										
29	0.54	0.73	0.30	0.28			11.4								8.2	7.2	22.9
30	0.65	0.71	0.26	0.26	30	10-15	14.2										
31	0.60	0.62	0.26	0.25			16.2								8.2	7.1	

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.8: PARTICULATE REMOVAL PROFILE (OCTOBER 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.62	0.71	0.27	0.25	20	10	16.3								8.3	7.0	17.3
2	0.73	0.71	0.30	0.29			16.5										
3	0.65	0.72	0.32	0.29			16.5										15.5
4	0.66	0.72	0.30	0.28			16.5										
5							16.5										
6							15.0								8.1	7.1	14
7	0.60	0.77	0.31	0.26	20-30	10	17.3										
8	0.62	0.65	0.31	0.30			16.7										
9	0.68	0.67	0.33	0.30			14.8								8.3	7.2	
10	0.70	0.71	0.32	0.28			17.0								8.1	7.1	
11	0.68	0.74	0.32	0.27	20-30	10	17.0								8.1	7.1	14
12							14.7										
13							13.4										
14							12.6										
15	0.61	0.82	0.34	0.4			17.5										

TABLE 2.8 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^oC)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.61	0.55	0.23	0.23	20-30	10	27.6								8.1	6.8	
17							25.8										
18	0.60	0.65	0.27	0.26			19.9								8.1	7.0	12.3
19							18.2										
20							20.5										
21	0.55	0.63	0.29	0.27	25	10	21.5								8.3	7.1	11.7
22	0.54	0.61	0.30	0.28			21.0										
23							14.7										
24	0.54	0.61	0.34	0.30			9.3								8.2		11.7
25	0.59	0.76	0.34	0.32			13.8										
26							13.6										
27							16.7										
28							7.3										
29							0										
30							0										
31							0										

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.9. PARTICULATE REMOVAL PROFILE (JANUARY 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AIO	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^{o}C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							0										
2							0										
3	0.38	0.38	0.34	0.35			0										
4	0.38	0.38	0.35	0.35			0										
5	0.38	0.39	0.35	0.35			0								7.9	7.5	
6							0										
7							0										
8							0										
9	0.39	0.39	0.32	0.35			0										
10							0										
11	0.35	0.35	0.32	0.31			0										
12	0.35	0.35	0.31	0.31			0								7.9	7.3	
13	0.36	0.35	0.31	0.31	15	5-10	0										
14							0										
15							0										

TABLE 2.9 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^oC)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.37	0.36	0.31	0.33	10-15	10	0								7.9	7.3	
17	0.35	0.35	0.31	0.31			0										
18	0.33	0.33	0.31	0.32			0										
19	0.37	0.36	0.28	0.32			0								7.8	7.3	
20	0.35	0.35	0.32	0.31	10-15	10	0										
21							0										
22							0										
23							0										
24							0								7.8	7.3	
25	0.39	0.39	0.37	0.37	15	10	0										
26	0.38	0.38	0.36	0.36			0										
27	0.39	0.39	0.35	0.35			0										
28							0										
29							0										
30	0.30	0.31	0.27	0.26			0										
31	0.31	0.30	0.27	0.25			0										

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.10. PARTICULATE REMOVAL PROFILE (APRIL 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AIO	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							0										
2	0.32	0.36	0.31	0.31			0										
3	0.32	0.33	0.28	0.27			0										
4	0.34	0.33	0.29	0.28			0										
5	0.56	0.42	0.32	0.31			0										
6	0.41	0.38	0.33	0.32			0										
7							0										
8							0										
9	0.38	0.39	0.30	0.30			0										
10	0.63	0.44	0.34	0.34			0										
11	0.45	0.43	0.31	0.31			0										
12	0.39	0.39	0.31	0.30			0										
13							0										
14							0										
15							0										

TABLE 2.10 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAC. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (^{o}C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16							0										
17							0										
18							0										
19	0.42	0.44	0.30	0.29			0										
20							0										
21							0										
22							0										
23							0										
24							0										
25							0										
26							0										
27							0										
28							0										
29							0										
30	0.43	0.45	0.33	0.36			0						0.018	0.005			
30 *							15						0.069	0.34			

* Started adding alum during the day.

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.11: PARTICULATE REMOVAL PROFILE (JULY 1984)

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DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							15.4										
2							14.0										
3	0.74	0.72	0.27	0.26			12.8								7.8	7.2	
4	0.78	0.69	0.29	0.30			8.2								7.7	7.1	
5	0.74	0.74	0.42	0.39	15-20	10-15	0								7.7	7.3	
6	0.75	0.75	0.40	0.41			0								7.4	7.0	
7							0										
8							0										
9	0.69	0.74	0.40	0.40			5.0										
10	0.71	0.85	0.34	0.34	15-20	15	7.6								7.9	7.3	
11	0.79	0.78	0.34	0.33			8.8								7.6	7.2	
12	0.80	0.78	0.34	0.30	15-20	10-15	10.9								8.0	7.3	
13							8.5										
14							6.8										
15							7.1										

TABLE 2.11 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.73	0.80	0.34	0.32			7.0								7.9	7.0	
17	0.71	0.79	0.35	0.33			7.2								7.9	7.2	
18	0.71	0.71	0.30	0.31			7.3								7.7	7.2	
19	0.73	0.66	0.37	0.36	20-30	10	5.7								7.8	7.2	
20	0.71	0.77	0.37	0.38	20	10-15	4.7								7.8	7.2	
21							0										
22							0										
23	0.79	0.76	0.39	0.38			3.6										
24	0.78	0.75	0.34	0.33	15-20	15	8.2								7.8	7.2	
25	0.80	0.79	0.32	0.30			3.6								7.8	7.2	
26	0.79	0.74	0.38	0.37			0										
27	0.80	0.71	0.44	0.40	20	15-20	2.2								7.7	7.3	
28							1.9										
29							0										
30	0.74	0.72	0.42	0.41	20	15-20	2.6								7.7	7.3	
31	0.72	0.74	0.34	0.33			6.8										

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 2.12: PARTICULATE REMOVAL PROFILE (OCTOBER 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (^{o}C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1							6.1										
2							9.1										
3							10.3										
4							0.5										
5							2.6										
6							8.3										
7							7.8										
8							7.4										
9							8.9										
10	0.65	0.90	0.35	0.36			9.4										
11							8.2										
12							9.0										
13							8.5										
14							8.7										
15	0.61	0.75	0.34	0.34			9.8								8.2	7.2	

TABLE 2.12 (cont'd.)

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DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al/Fe (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L.	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.61	0.76	0.32	0.30			8.4								8.2	7.2	
17	0.61	0.80	0.34	0.32	15	10-15	10.4										
18	0.65	0.77	0.33	0.31			11.5								8.2	7.2	
19	0.64	0.85	0.39	0.34			6.5										
20							6.6										
21							6.4										
22	0.60	0.86	0.38	0.34			10.1										
23	0.58	0.90	0.38	0.34			8.0										
24	0.56	0.82	0.35	0.34	15-20	5-10	7.8								8.1	7.2	
25							7.5										
26							7.6										
27							6.9										
28							7.7										
29	0.55	0.73	0.35	0.33			7.6										13
30	0.54	0.80	0.32	0.31			8.6										
31	0.53	0.72	0.34	0.33	20	10-15	10.5								8.2	7.1	

Sources: Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

Turbidity, colour, pH, temperature, aluminum residual - Laboratory Daily Log Books. Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is less accurate than atomic absorption methods.

TABLE 3.0: DISINFECTION SUMMARY

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JAN	Cl_2 Demand																		
	Cl_2 Dosage	5.0	4.5	4.9				3.0	3.0	3.0	0.59	0.19	0.33	3.5	3.0	3.2	0.53	0.10	0.33
	NH_3																		
	SO_2				0.65	0.26	0.43												
	Cl_2 Res. (Free)				1.34	0.65					1.45	1.04					1.22	1.02	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.67	1.35	1.4				1.72	1.29	1.4				1.51	1.28	1.4
	F- Dosage				0.95	0.59	0.77				1.08	0.28	0.81				0.88	0.23	0.77
	F- Res.				1.27	1.13	1.20				1.24	1.00	1.17				1.39	1.19	1.30
FEB	Cl_2 Demand																		
	Cl_2 Dosage	5.0	4.0	4.9				3.5	3.0	3.3	0.34	0.05	0.21	4.0	3.5	3.6	0.44	0.17	0.29
	NH_3																		
	SO_2				0.75	0.35	0.53												
	Cl_2 Res. (Free)				1.30	0.93					1.27	0.82					1.32	0.80	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.65	1.23	1.4				1.53	1.09	1.4				1.64	1.18	1.4
	F- Dosage				0.86	0.70	0.77				1.09	0.54	0.84				0.96	0.66	0.82
	F- Res.				1.25	1.10	1.19				1.27	1.15	1.19				1.35	1.18	1.27
MAR	Cl_2 Demand																		
	Cl_2 Dosage	5.0	4.5	5.0				3.5	3.0	3.4	0.74	0.05	0.25	4.0	4.0	4.0	0.43	0.14	0.27
	NH_3																		
	SO_2				0.88	0.42	0.60												
	Cl_2 Res. (Free)				1.30	0.98					1.48	0.92					1.35	0.97	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.63	1.29	1.4				1.79	1.22	1.4				1.62	1.28	1.4
	F- Dosage				0.92	0.50	0.79				0.95	0.65	0.83				0.98	0.66	0.82
	F- Res.				1.26	1.12	1.19				1.25	1.10	1.19				1.36	1.20	

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

See additional notes at end of Table (p.5).

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
APR	Cl_2 Demand																		
	Cl_2 Dosage	5.0	4.0	4.5				3:5	3.0	3.05	0.56	0.10	0.30	4.0	4.0	4.0	0.34	0.09	0.21
	NH_3																		
	SO_2				0.78	0.21	0.48												
	Cl_2 Res. (Free)				0.91	1.50					1.51	0.82					1.33	0.62	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.78	1.22	1.4				1.76	1.04	1.4				1.63	0.86	1.4
	F- Dosage				0.95	0.65	0.79				0.92	0.29	0.75*				0.94	0.71	0.85
	F- Res.				1.26	1.10	1.19				1.20	1.10	1.15				1.40	1.05	1.25
MAY	Cl_2 Demand																		
	Cl_2 Dosage	5.0	4.5	5.0				4.0	3.5	3.9	0.45	0.04	0.25	4.5	4.0	4.0	0.48	0.10	0.24
	NH_3																		
	SO_2				0.54	0.10	0.31												
	Cl_2 Res. (Free)				1.32	0.76					1.50	0.95					1.40	0.85	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.85	1.02	1.4				1.74	1.17	1.4				1.55	1.07	1.4
	F- Dosage				0.97	0.49	0.77				1.05	0.55	0.88				1.01	0.43	0.86 **
	F- Res.				1.25	1.05	1.17				1.25	1.10	1.20				1.45	1.00	1.20
JUN	Cl_2 Demand										(1)	(1)	(1)						
	Cl_2 Dosage	4.5	4.5	4.5				5.0	4.0	0.45	0.26	0.04	0.15	4.5	4.0	4.2	0.47	0.15	0.34
	NH_3										(2)	(2)	(2)						
	SO_2				0.49	0.14	0.34				0.37	0.13	0.24						
	Cl_2 Res. (Free)				1.47	0.82					1.50	0.75					1.41	0.90	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.74	1.07	1.4				1.80	1.00	1.4				1.70	1.10	1.4
	F- Dosage				0.97	0.69	0.81				1.12	0.79	0.91				1.05	0.55	0.89
	F- Res.				1.27	1.09	1.19				1.24	1.15	1.20				1.40	1.05	1.18

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

See additional notes at end of Table (p.5).

MONTH	CHEMICAL	1986						1985						1984						
		PRE-			POST-			PRE-			POST-			PRE-			POST-			
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	
JUL	Cl_2 Demand																(4)	(4)	(4)	
	Cl_2 Dosage	5.0	4.5	4.5				5.5	4.5	5.1				5.0	4.0	4.7	0.37	0.08	0.22	
	NH_3																(5)	(5)	(5)	
	SO_2				0.48	0.04	0.28				0.61	0.09	0.33				0.26	0.09	0.19	
	Cl_2 Res. (Free)				1.56	1.05					1.48	0.95					1.41	0.83		
	Cl_2 Res. (Comb.)																			
	Cl_2 Res. (Total)				1.66	1.31	1.4				1.78	1.20	1.4				1.66	1.14	1.4	
	F- Dosage				0.98	0.62	0.74				1.10	0.70	0.93				1.11	0.73	0.93	(3)
	F- Res.				1.26	1.13	1.20				1.24	1.14	1.19				1.40	1.08	1.20	
AUG	Cl_2 Demand																			
	Cl_2 Dosage	5.0	4.8	5.0				5.5	5.5	5.5				5.5	5.0	5.0				
	NH_3																			
	SO_2				0.62	0.05	0.37				0.92	0.29	0.60				0.36	0.04	0.19	
	Cl_2 Res. (Free)				1.75	0.95					1.88	0.92					1.39	0.86		
	Cl_2 Res. (Comb.)																			
	Cl_2 Res. (Total)				2.05	1.27	1.4				2.05	1.20	1.4				1.73	1.16	1.4	
	F- Dosage				0.91	0.22	0.70				1.20	0.28	0.95				1.22	0.81	0.95	
	F- Res.				1.23	1.05	1.17				1.25	1.13	1.19				1.28	1.16	1.21	
SEP	Cl_2 Demand																			
	Cl_2 Dosage	5.0	4.5	4.8				5.5	5.0	5.3				6.0	5.0	5.3				
	NH_3																		(7)	
	SO_2				0.71	0.21	0.54				0.70	0.22	0.45				0.73	0.06	0.36	
	Cl_2 Res. (Free)				1.45	0.80					1.62	1.01					1.65	0.72		
	Cl_2 Res. (Comb.)																			
	Cl_2 Res. (Total)				1.81	1.15	1.4				1.92	1.30	1.4				1.05	1.04	1.4	
	F- Dosage				0.87	0.22	0.71				0.98	0.71	0.83				1.19	0.68	0.92	(6)
	F- Res.				1.27	1.09	1.18				1.29	1.10	1.17				1.30	1.15	1.22	

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

See additional notes at end of Table (p.5).

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
OCT	Cl_2 Demand				(8)	(8)	(8)												
	Cl_2 Dosage	5.0	3.5	4.4	0.15	0.05	0.11	5.0	3.8	4.3				5.0	4.5	4.6			
	NH_3				(9)	(9)	(9)												
	SO_2				0.67	0.19	0.46				0.66	0.04	0.30				0.72	0.05	0.26
	Cl_2 Res. (Free)				1.53	0.80					2.31	0.91					1.70	0.88	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				2.20	1.10	1.4				2.60	1.16	1.4				2.06	1.21	1.4
	F- Dosage				1.00	0.20	0.70				1.15	0.61	0.78				1.25	0.76	0.90
	F Res.				1.20	1.00	1.10				1.25	1.09	1.17				1.37	1.04	1.20
NOV	Cl_2 Demand										(10)	(10)	(10)				(12)	(12)	(12)
	Cl_2 Dosage	3.5	3.0	3.2	0.44	0.05	0.25	3.5	3.0	3.2	0.47	0.09	0.25	4.5	3.5	4.1	0.24	0.05	0.13
	NH_3										(11)	(11)	(11)				(13)	(13)	(13)
	SO_2										0.10	0.09	0.10				0.69	0.10	0.38
	Cl_2 Res. (Free)				1.46	0.70					1.76	0.89					1.47	1.00	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				1.75	0.95	1.4				2.01	1.30	1.4				1.67	1.18	1.4
	F- Dosage										0.91	0.12	0.76**				0.99	0.76	0.86
	F- Res.										1.27	1.09	1.18				1.22	1.10	1.19
DEC	Cl_2 Demand				(15)	(15)	(15)				(16)	(16)	(16)						
	Cl_2 Dosage	4.0	3.0	3.6	0.49	0.14	0.27	4.5	3.0	3.9	0.50	0.09	0.28	3.5	3.0	3.1	0.74	0.22	0.39
	NH_3				(13)	(13)	(13)				(17)	(17)	(17)						
	SO_2				0.40	0.05	0.26				0.94	0.09	0.52						
	Cl_2 Res. (Free)				1.74	0.93					1.68	0.92					1.98	1.09	
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				2.02	1.19	1.4				1.93	1.15	1.4				2.21	1.32	1.4
	F Dosage				1.01	0.54	0.78(14)				1.06	0.76	0.88				1.18	0.44	0.93
	F- Res.				1.23	1.00	1.11				1.25	1.15	1.20				1.20	1.14	1.17

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

See additional notes at end of Table (p.5).

* = Fluoride applied for 14 days
** = Fluoride applied for 29 days
(1) = Post-chlorine applied for 5 days
(2) = Sulphur dioxide applied for 26 days
(3) = Data available for 27 days
(4) = Post-chlorine applied for 19 days
(5) = Sulphur dioxide applied for 28 days
(6) = Fluoride applied for 28 days
(7) = Average of 29 days
(8) = Post-chlorine applied for 3 days
(9) = Sulphur dioxide applied for 29 days
(10) = Post-chlorine data available for 23 days
(11) = Sulphur dioxide applied for 4 days
(12) = Post-chlorine applied for 11 days
(13) = Sulphur dioxide applied for 20 days
(14) = Fluoride dosage data available for 28 days
(15) = Post-chlorine applied for 12 days
(16) = Post-chlorine applied for 16 days
(17) = Sulphur dioxide applied for 16 days
(18) = Fluoride dosage applied for 30 days

TABLE 3.1 DISINFECTION PROFILE (JAN/1986)

DATE	PRE-CHLORINATION							POST CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		4.5							0		0.42				0.87	
2		4.5			1.75	0.24	1.99		0		0.44	1.25	0.30	1.55	0.59	1.18
3		4.5			1.72	0.33	2.05		0		0.53	1.05	0.30	1.35	0.67	1.17
4		4.5							0		0.58				0.77	
5		4.5							0		0.65				0.73	
6		4.5			1.98	0.37	2.35		0		0.52	1.06	0.32	1.40	0.89	
7		4.5			1.86	0.34	2.20		0		0.47	0.65	0.25	0.90	0.84	1.23
8		4.5			2.04	0.37	2.41		0		0.60	1.12	0.38	1.50	0.73	
9		4.5			1.77	0.33	2.10		0		0.44	1.34	0.33	1.67	0.78	1.21
10		5.0			1.53	0.33	1.86		0		0.26	1.21	0.32	1.53	0.82	1.22
11		5.0							0		0.31				0.78	
12		5.0							0		0.39				0.74	
13		5.0			1.61	0.32	1.93		0		0.32	1.23	0.30	1.53	0.79	1.18
14		5.0			1.64	0.33	1.97		0		0.28	1.08	0.29	1.37	0.83	1.26
15		5.0			1.65	0.33	1.98		0		0.30	1.17	0.29	1.46	0.79	
16		5.0							0		0.30				0.77	
17		5.0			1.73	0.30	2.03		0		0.32	1.12	0.34	1.46	0.68	
18		5.0							0		0.37				0.74	
19		5.0							0		0.29				0.73	
20		5.0			1.61	0.36	1.97		0		0.32	1.10	0.34	1.44	0.84	
21		5.0			1.73	0.34	2.07		0		0.34	1.15	0.32	1.47	0.95	
22		5.0			1.70	0.35	2.05		0		0.36	1.08	0.32	1.40	0.80	
23		5.0			1.75	0.33	2.08		0		0.35	1.18	0.33	1.51	0.79	1.27
24		5.0			1.70	0.33	2.03		0		0.44	1.24	0.29	1.53	0.70	1.23
25		5.0							0		0.53				0.75	
26		5.0							0		0.49				0.73	
27		5.0			1.88	0.38	2.26		0		0.44	1.12	0.31	1.43	0.80	1.13
28		5.0			1.77	0.35	2.12		0		0.51	1.04	0.34	1.38	0.66	1.13
29		5.0			1.83	0.33	2.16		0		0.59	1.10	0.29	1.39	0.73	1.22
30		5.0			1.82	0.35	2.17		0		0.54	1.15	0.31	1.46	0.72	1.21
31		5.0			1.86	0.36	2.22		0		0.56	1.12	0.31	1.43	0.73	

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		4.5			2.21	0.36	2.57		0		0.76	1.26	0.36	1.62	0.76	1.11
2		4.5			2.15	0.36	2.51		0		0.78	0.91	0.31	1.22	0.76	
3		4.5			1.94	0.31	2.25		0		0.53	1.04	0.31	1.35	0.83	1.12
4		4.5			1.76	0.36	2.12		0		0.54	1.10	0.30	1.40	0.79	1.22
5		4.5							0		0.53				0.85	
6		4.5							0		0.45				0.73	
7		4.5			1.70	0.32	2.02		0		0.61	1.05	0.28	1.33	0.83	
8		4.5			2.02	0.33	2.35		0		0.75	1.13	0.29	1.42	0.70	
9		4.5							0		0.77				0.77	
10		4.5							0		0.68				0.86	
11		4.5			2.03	0.38	2.41		0		0.67	1.24	0.22	1.46	0.79	
12		4.5							0		0.65				0.80	
13		4.5							0		0.64				0.81	
14		4.5							0		0.38				0.88	
15		4.5							0		0.23				0.84	
16		4.0			2.46	0.25	2.71		0		0.62	1.30	0.20	1.50	0.79	1.22
17		4.5			1.60	0.22	1.82		0		0.23	1.07	0.20	1.27	0.86	1.24
18		4.5			1.72	0.32	2.04		0		0.26	1.28	0.26	1.54	0.66	1.26
19		4.5							0		0.30				0.79	
20		4.5							0		0.26				0.70	
21		4.5			1.54	0.31	1.85		0		0.30	1.19	0.25	1.44	0.95	1.24
22		4.5			1.75	0.28	2.03		0		0.32	1.40	0.25	1.65	0.81	1.20
23		4.5			1.92	0.31	2.23		0		0.48	1.50	0.28	1.78	0.76	1.10
24		4.5							0		0.59				0.68	
25		4.5			1.95	0.30	2.25		0		0.56	1.00	0.26	1.26	0.65	1.19
26		4.5							0		0.43				0.76	
27		4.5							0		0.33				0.77	
28		4.5			1.51	0.31	1.82		0		0.21	1.12	0.29	1.41	0.77	1.22
29		5.0			1.48	0.29	1.77		0		0.23	1.05	0.27	1.32	0.82	
30		5.0			1.88	0.31	2.19		0		0.45	1.07	0.28	1.35	0.84	
31																

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.3: DISINFECTION PROFILE (JUL/1986)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		4.5							0		0.48				0.70	
2		4.5			2.01	0.29	2.30		0		0.43	1.33	0.28	1.61	0.86	1.25
3		4.5			2.04	0.34	2.38		0		0.42	1.29	0.28	1.57	0.68	1.26
4		4.5			2.28	0.32	2.60		0		0.45	1.22	0.25	1.47	0.71	1.24
5		4.5							0		0.27				0.73	
6		4.5							0		0.36				0.69	
7		4.5			1.96	0.36	2.32		0		0.32	1.28	0.29	1.57	0.71	1.19
8		4.5			1.82	0.34	2.16		0		0.42	1.29	0.28	1.57	0.98	1.15
9		4.5			1.79	0.32	2.11		0		0.31	1.26	0.17	1.43	0.77	1.24
10		4.5			1.86	0.35	2.21		0		0.35	1.42	0.29	1.71	0.83	1.17
11		4.5			1.72	0.31	2.03		0		0.29	1.14	0.29	1.43	0.79	1.14
12		4.5							0		0.24				0.76	
13		4.5							0		0.27				0.92	
14		4.5			1.86	0.32	2.18		0		0.47	1.14	0.28	1.42	0.64	1.15
15		4.5			2.15	0.29	2.44		0		0.35	1.08	0.23	1.31	0.68	1.13
16		4.5			2.15	0.34	2.49		0		0.37	1.11	0.29	1.40	0.62	
17		4.5			1.82	0.38	2.20		0		0.26	1.31	0.35	1.66	0.64	1.15
18		4.5			2.05	0.33	2.38		0		0.42	1.16	0.28	1.44	0.74	1.18
19		4.5							0		0.28				0.75	
20		4.5							0		0.16				0.72	
21		4.5							0		0.22	1.35	0.27	1.62	0.76	
22		4.5			1.90	0.27	2.17		0		0.20	1.36	0.28	1.64	0.70	1.22
23		4.5			1.65	0.32	1.97		0		0.22	1.31	0.26	1.57	0.77	1.17
24		4.5			1.70	0.32	2.02		0		0.30	1.20	0.30	1.50	0.72	1.19
25		4.5			1.60	0.36	1.96		0		0.09	1.20	0.30	1.50	0.80	1.26
26		4.5							0		0.05				0.73	
27		4.5							0		0.04				0.74	
28		4.5			2.05	0.39	2.44		0		0.15	1.45	0.36	1.81	0.80	1.19
29		5.0			1.55	0.37	1.92		0		0.04	1.05	0.30	1.35	0.63	1.18
30		5.0			2.05	0.38	2.43		0		0.13	1.56	0.32	1.88	0.75	
31		5.0			1.97	0.37	2.34		0		0.24	1.25	0.32	1.57	0.76	1.20

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.4. DISINFECTION PROFILE (OCT/1986)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		4.5			1.75	0.35	2.10		0		0.34	1.22	0.30	1.52	0.69	1.10
2		4.5			1.81	0.35	2.16		0		0.33	1.35	0.32	1.67	0.80	1.05
3		4.5			1.70	0.35	2.05		0		0.40	0.80	0.30	1.10	0.77	
4		4.5							0		0.39				0.78	
5		4.5							0		0.36				0.78	
6		4.5			1.83	0.36	2.19		0		0.49				0.68	1.08
7		4.5			1.80	0.35	2.15		0		0.43	0.96	0.28	1.24	0.78	
8		4.5			2.20	0.39	2.59		0		0.35	1.53	0.37	1.90	0.92	
9		4.5			2.20	0.41	2.61		0		0.58	1.49	0.36	1.85	1.00	1.05
10		4.5			1.71	0.36	2.07		0		0.39	1.06	0.34	1.40	0.81	
11		4.5							0		0.51				0.76	
12		4.5							0		0.54				0.75	
13		4.5							0		0.59				0.83	
14		4.5			1.84	0.38	2.22		0		0.48	1.15	0.35	1.50	0.76	
15		5.0			2.00	0.38	2.38		0		0.54	0.82	0.32	1.14	0.65	
16		4.0			2.35	0.40	2.75		0		0.24	1.90	0.30	2.20	0.72	
17		4.5			1.70	0.36	2.06		0		0.22	1.42	0.33	1.75	0.65	1.20
18		4.5							0		0.52				0.96	
19		4.5							0		0.62				0.79	
20		4.5			1.87	0.39	2.26		0		0.43	1.35	0.31	1.66	0.72	
21		4.5			1.98	0.27	2.25		0		0.60				0.74	
22		4.5			2.15	0.34	2.49		0		0.55				0.76	
23		4.5			1.93	0.33	2.25		0		0.67	1.15	0.27	1.42	0.62	
24		4.5			2.07	0.36	2.43		0		0.65	1.04	0.29	1.33	0.67	
25		4.5							0		0.61				0.75	
26		4.5							0		0.42				0.69	
27		4.5			1.92	0.37	2.29		0		0.53	1.08	0.30	1.38	0.62	1.00
28		4.5			1.97	0.35	2.32		0		0.40	1.23	0.30	1.53	0.59	
29		3.5			1.61	0.32	1.93		0.05		0.19	1.09	0.31	1.40	0.53	1.20
30		3.5			1.50	0.35	1.85		0.15		0	1.23	0.34	1.57	0.20	
31		3.5			1.62	0.32	1.94		0.14		0	1.39	0.31	1.70	0	

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.5: DISINFECTION PROFILE (JAN/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		3.0							0.27		0				1.06	
2		3.0			1.24	0.29	1.53		0.33		0	1.20	0.30	1.50	0.98	1.23
3		3.0			0.94	0.23	1.17		0.37		0	1.20	0.27	1.47	0.78	
4		3.0			0.91	0.29	1.20		0.33		0	1.05	0.25	1.30	1.08	1.24
5		3.0							0.28		0				0.91	
6		3.0							0.32		0				0.92	
7		3.0			1.23	0.29	1.52		0.27		0	1.32	0.27	1.59	0.88	1.15
8		3.0			1.00	0.28	1.28		0.29		0	1.24	0.27	1.51	0.88	1.10
9		3.0			1.10	0.22	1.32		0.30		0	1.28	0.24	1.52	0.89	1.15
10		3.0			1.22	0.27	1.49		0.24		0	1.45	0.27	1.72	0.72	
11		3.0			0.86	0.25	1.11		0.30		0	1.13	0.22	1.35	0.84	1.21
12		3.0							0.30		0				0.41	
13		3.0							0.22		0				0.28	
14		3.0			1.13	0.29	1.42		0.30		0	1.12	0.28	1.40	0.54	
15		3.0			1.05	0.28	1.32		0.30		0	1.12	0.28	1.40	0.91	1.15
16		3.0			1.02	0.28	1.30		0.34		0	1.26	0.27	1.53	0.68	1.18
17		3.0			0.98	0.23	1.21		0.30		0	1.09	0.27	1.36	0.67	1.00
18		3.0			1.21	0.38	1.59		0.21		0	1.12	0.29	1.41	0.89	1.20
19		3.0							0.26		0				0.81	
20		3.0							0.26		0				0.88	
21		3.0			1.33	0.34	1.67		0.30		0	1.28	0.27	1.55	0.87	1.17
22		3.0			0.86	0.27	1.13		0.42		0	1.04	0.25	1.29	0.91	
23		3.0			0.87	0.27	1.14		0.43		0	1.16	0.24	1.40	0.95	1.20
24		3.0			0.90	0.27	1.17		0.40		0	1.20	0.26	1.46	0.76	1.20
25		3.0							0.49		0				0.76	
26		3.0							0.59		0				0.69	
27		3.0							0.54		0				0.86	
28		3.0			0.56	0.26	0.82		0.41		0	1.43	1.65	1.71	0.79	
29		3.0			1.06	0.28	1.34		0.27		0	1.23	0.28	1.51	0.82	1.18
30		3.0			1.13	0.29	1.42		0.28		0	1.26	0.29	1.55	0.82	
31		3.0			0.96	0.28	1.24		0.19		0	1.04	0.25	1.29	0.85	1.18

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.6: DISINFECTION PROFILE (APR/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		3.0			1.02	0.26	1.28		0.27		0	1.06	0.24	1.30	0.88	
2		3.0			1.03	0.27	1.30		0.24		0	0.82	0.22	1.04	0.29	
3		3.0			1.10	0.24	1.34		0.24		0	1.16	0.18	1.34	0	
4		3.0			1.21	0.23	1.44		0.20		0	1.20	0.22	1.42	0	
5		3.0							0.15		0				0	
6		3.0							0.10		0				0	
7		3.0							0.11		0				0	
8		3.0							0.10		0				0	
9		3.0			1.05	0.22	1.27		0.19		0	0.90	0.20	1.10	0	
10		3.0			1.21	0.22	1.43		0.21		0	1.21	0.20	1.41	0	
11		3.0			1.19	0.21	1.40		0.33		0	1.14	0.18	1.32	0	
12		3.25			1.58	0.25	1.83		0.28		0	1.51	0.25	1.76	0	
13		3.0							0.51		0				0	
14		3.0							0.41		0				0	
15		3.0			1.06	0.24	1.30		0.31		0	1.33	0.24	1.57	0	
16		3.5			1.12	0.22	1.34		0.29		0	1.28	0.22	1.50	0	
17		3.5			2.00	0.20	2.20				0	1.35	0.20	1.55	0	
18		3.5			2.05	0.21	2.26		0.23		0	1.28	0.22	1.50	0	
19		3.25			2.07	0.22	2.29		0.49		0	1.40	0.26	1.66	0.38	
20		3.0							0.26		0				0.70	
21		3.0							0.32		0				0.79	
22		3.0			1.28	0.25	1.53		0.40		0	1.22	0.23	1.47	0.81	1.10
23		3.5			1.23	0.24	1.47		0.29		0	1.25	0.21	1.46	0.74	1.20
24		3.0			1.03	0.17	1.20		0.43		0	1.11	0.14	1.25	0.72	
25		3.0			0.97	0.25	1.22		0.34		0	1.50	0.19	1.69	0.86	1.15
26		3.0							0.35		0				0.81	
27		3.5							0.56		0				0.87	
28		3.5							0.21		0				0.91	
29		3.5			0.97	0.27	1.24		0.29		0	1.02	0.23	1.25	0.92	
30		3.5			1.55	0.28	1.83		0.52		0	1.26	0.22	1.48	0.78	
31																

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.7. DISINFECTION PROFILE (JUL/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		5.0							0		0.49				0.99	
2		4.75			2.06	0.36	2.42		0		0.23	0.95	0.25	1.20	0.70	
3		4.75			2.12				0		0.25			1.60	0.83	
4		5.0			2.50	0.32	2.82		0		0.18	1.28	0.27	1.55	0.76	1.17
5		5.0			2.11	0.37	2.48		0		0.42	1.19	0.30	1.49	0.82	
6		5.0							0		0.09				0.95	
7		5.0							0		0.15				0.83	
8		5.0			2.16	0.38	2.54		0		0.38	1.35	0.31	1.66	0.90	1.22
9		5.0			2.10	0.33	2.43		0		0.33	1.10	0.26	1.36	0.80	
10		5.0			2.53	0.34	2.87		0		0.43	1.48	0.30	1.78	0.86	
11		4.75			2.13	0.31	2.46		0		0.56	1.12	0.26	1.38	0.89	1.18
12		4.75			2.05	0.33	2.38		0		0.47	1.25	0.31	1.54	1.01	1.18
13		4.5							0		0.18				0.87	
14		5.0							0		0.28				0.96	
15		5.0			1.92	0.38	2.30		0		0.29	1.05	0.27	1.32	0.98	1.22
16		5.0			1.68	0.36	2.04		0		0.13	1.13	0.29	1.42	1.01	1.18
17		5.0			1.90	0.36	2.26		0		0.31	1.19	0.32	1.51	1.09	1.22
18		5.0			2.10	0.36	2.46		0		0.29	1.42	0.32	1.74	0.99	1.22
19		5.5							0		0.61				0.88	
20		5.5							0		0.45				0.98	
21		5.5							0		0.44				1.06	
22		5.5			2.07	0.37	2.44		0		0.39	1.00	0.28	1.28	1.01	1.17
23		5.5			1.97	0.36	2.33		0		0.32	1.23	0.30	1.53	0.92	1.16
24		5.5			2.16	0.35	2.51		0		0.35	1.13	0.29	1.42	0.80	
25		5.0			1.95	0.33	2.28		0		0.30	1.15	0.31	1.46	1.00	1.22
26		5.0			1.90	0.34	2.24		0		0.26	1.13	0.29	1.42	0.89	1.18
27		5.0							0		0.29				0.91	
28		5.0							0		0.29				0.98	
29		5.5			1.62	0.45	2.07		0		0.32	1.05	0.31	1.36	1.02	1.17
30		5.5			1.95	0.34	2.29		0		0.35	1.16	0.30	1.46	0.98	1.14
31		5.5			1.93	0.35	2.28		0		0.25	1.12	0.30	1.42	1.10	1.24

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 38. DISINFECTION PROFILE (OCT/1985)

DATE	PRE CHLORINATION							POST CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		5.0			2.03	0.35	2.38		0		0.29	1.45	0.33	1.78	0.87	1.18
2		5.0			2.12	0.30	2.42		0		0.51	1.25	0.28	1.53	0.88	1.21
3		5.0			2.67	0.32	2.99		0		0.60	1.53	0.30	1.83	0.86	1.17
4		4.5			2.40	0.37	2.77		0		0.66	2.31	0.29	2.60	0.79	
5		4.5							0		0.28				0.8	
6		4.5							0		0.19				0.73	
7		4.5			1.87	0.35	2.22		0		0.23	1.31	0.28	1.59	0.87	1.20
8		4.5			1.97	0.31	2.28		0		0.32	1.42	0.28	1.70	0.75	1.25
9		4.5			1.87	0.31	2.18		0		0.43	1.20	0.28	1.48	0.80	1.24
10		4.5			1.82	0.29	2.11		0		0.40	0.91	0.25	1.16	0.79	1.17
11		4.5			1.96	0.35	2.31		0		0.38	1.14	0.29	1.43	0.78	
12		4.5							0		0.39				0.73	
13		4.5							0		0.26				0.69	
14		4.5							0		0.25				0.61	
15		4.5			1.94	0.34	2.28		0		0.37	1.02	0.25	1.27	0.78	
16		4.5			2.15	0.27	2.42		0		0.41	1.22	0.20	1.44	0.72	
17		4.5							0		0.41				0.70	
18		4.0			2.16	0.31	2.47		0		0.32	1.60	0.30	1.90	0.64	1.09
19		4.0							0		0.21				0.64	
20		4.0							0		0.19				0.74	
21		4.0			1.81	0.29	2.10		0		0.19	1.39	0.26	1.65	0.69	1.12
22		4.0			1.77	0.29	2.06		0		0.31	1.16	0.27	1.43	0.80	1.22
23		4.0							0		0.09				0.68	
24		4.0			1.72	0.34	2.06		0		0.26	1.16	0.30	1.46	0.77	1.17
25		4.0			1.80	0.35	2.15		0		0.29	1.35	0.31	1.66	0.83	1.23
26		4.0							0		0.28				0.81	
27		4.0							0		0.29				0.93	
28		4.0							0		0.12				0.85	
29		4.0							0		0.05				1.15	
30		4.0			2.03				0		0.04			2.05	0.76	
31		3.75			2.07	0.33	2.40		0		0.22	0.98	0.30	1.28	0.73	1.23

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 39 DISINFECTION PROFILE (JAN/1984)

DATE	PRE-CHLORINATION							POST CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		3.0							0.29		0				0.78	
2		3.5							0.25		0				0.76	
3		3.5			1.16	0.33	1.49		0.13		0	1.13	0.33	1.46	0.87	1.19
4		3.5			1.11	0.27	1.38		0.14		0	1.13	0.31	1.44	0.78	
5		3.5			1.08	0.32	1.40		0.15		0	1.18	0.30	1.48	0.78	1.24
6		3.5			1.16	0.25	1.41		0.13		0	1.19	0.28	1.47	0.73	
7		3.5							0.15		0				0.80	
8		3.5							0.10		0				0.73	
9		3.5			1.14	0.27	1.41		0.18		0	1.14	0.31	1.45	0.82	1.23
10		3.0			1.05	0.23	1.28		0.22		0	1.08	0.29	1.37	0.83	
11		3.0			0.72	0.28	1.00		0.35		0	1.02	0.26	1.28	0.81	1.26
12		3.0			0.76	0.35	1.11		0.36		0	1.22	0.26	1.48	0.83	
13		3.0			0.89	0.30	1.19		0.41		0	1.12	0.27	1.39	0.88	1.39
14		3.0							0.51		0				0.23	
15		3.0							0.53		0				0.77	
16		3.0			0.90	0.31	1.21		0.41		0	1.13	0.32	1.45	0.86	1.38
17		3.0			0.77	0.29	1.06		0.37		0	1.08	0.28	1.36	0.78	
18		3.0			0.76	0.27	1.03		0.47		0	1.15	0.30	1.45	0.86	1.31
19		3.0			0.77	0.30	1.07		0.47		0	1.07	0.31	1.38	0.83	1.38
20		3.0			0.71	0.31	1.02		0.46		0	1.07	0.34	1.41	0.81	1.35
21		3.0							0.40		0				0.84	
22		3.0							0.35		0				0.79	
23		3.0			0.70	0.28	0.98		0.50		0	1.08	0.30	1.38	0.78	1.34
24		3.0			0.63	0.30	0.93		0.45		0	1.10	0.30	1.40	0.84	1.31
25		3.0			0.65	0.26	0.91		0.53		0	1.18	0.27	1.45	0.74	
26		3.5			0.61	0.33	0.94		0.37		0	1.14	0.37	1.51	0.75	1.31
27		3.5			1.12	0.27	1.39		0.30		0	1.16	0.32	1.48	0.74	1.25
28		3.5							0.30		0				0.79	
29		3.0							0.31		0				0.75	
30		2.5			0.96	0.28	1.24		0.23		0	1.22	0.29	1.51	0.75	1.23
31		2.5			1.01	0.28	1.29		0.23		0	1.16	0.30	1.46	0.69	

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.10 DISINFECTION PROFILE (APR/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		3.0							0.10		0				0.74	
2		3.0			1.22	0.36	1.58		0.18		0	1.33	0.30	1.63	0.77	1.22
3		3.0			0.95	0.29	1.24		0.09		0	0.62	0.24	0.86	0.84	
4		3.0			0.96	0.28	1.24		0.24		0	1.08	0.27	1.35	0.76	
5		3.0			1.02	0.29	1.31		0.27		0	1.07	0.32	1.39	0.77	1.22
6		3.0			1.07	0.30	1.37		0.36		0	1.31	0.23	1.54	0.87	1.32
7		3.0							0.32		0				0.90	
8		3.0							0.32		0				0.93	
9		3.0			1.07	0.30	1.37		0.31		0	1.14	0.27	1.41	0.92	1.36
10		3.0			1.36	0.27	1.63		0.09		0	1.16	0.32	1.48	0.84	
11		3.0			1.38	0.26	1.64		0.09		0	1.14	0.26	1.42	0.80	
12		3.0			2.35	0.29	2.64		0.15		0	1.20	0.24	1.44	0.90	
13		3.0							0.34		0				0.88	
14		3.0							0.11		0				0.85	
15		3.0							0.10		0				0.83	
16		3.0							0.15		0				0.93	
17		3.0			1.20	0.22	1.42		0.15		0	1.18	0.27	1.45	0.94	
18		3.0							0.24		0				0.85	
19		3.0			0.99	0.28	1.27		0.33		0	1.04	0.31	1.35	0.92	1.12
20		3.0							0.33		0				0.85	
21		3.0							0.26		0				0.87	
22		3.0							0.29		0				0.88	
23		3.0							0.21		0				0.83	
24		3.0			1.30	0.23	1.53		0.19		0	1.04	0.24	1.28	0.71	
25		3.0							0.34		0				0.79	
26		3.0							0.10		0				0.86	
27		3.0							0.15		0				0.86	
28		3.0							0.11		0				0.83	
29		3.0							0.22		0				0.82	
30		3.0			1.01	0.25	1.26		0.15		0	0.98	0.24	1.22	0.85	
31																

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3 11 DISINFECTION PROFILE (JUL/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		4.5							0.17		0				0.96	
2		4.5							0.20		0				0.93	
3		4.5			1.39	0.47	1.86		0.21		0	1.23	0.28	1.51	0.73	1.20
4		4.5			1.73	0.36	2.09		0.13		0	1.24	0.30	1.54	0.92	1.21
5		4.5			1.44	0.34	1.78		0.23		0	1.22	0.27	1.49	0.83	1.17
6		4.5			1.52	0.35	1.87		0.29		0	1.34	0.32	1.66	0.91	1.22
7		4.5							0.36		0				0.77	
8		4.5							0.24		0				0.75	
9		4.5			1.40	0.35	1.75		0.27		0	1.08	0.29	1.37	0.92	1.08
10		4.25			1.21	0.28	1.49		0.08		0	1.00	0.22	1.22	1.06	1.15
11		4.0			1.60	0.31	1.91		0.21		0	1.11	0.27	1.38	1.11	1.40
12		4.25			1.04	0.26	1.30		0.37		0	1.06	0.28	1.34	1.06	1.25
13		4.5							0.24		0				0.83	
14		4.5							0.21		0				0.85	
15		4.5							0.28		0				0.88	
16		4.5			1.31	0.41	1.72		0.18		0	1.26	0.31	1.57	0.95	1.23
17		4.5			1.44	0.34	1.78		0.12		0	1.16	0.24	1.40	0.92	1.15
18		4.5			1.35	0.31	1.66		0.18		0	0.83	0.35	1.18	1.03	1.18
19		4.75			1.80	0.29	2.09		0.19		0	1.41	0.24	1.65	0.92	1.19
20		5.0			1.95	0.37	2.32		0		0.23	1.14	0.33	1.47	0.92	1.19
21		5.0							0		0.24				0.90	
22		5.0							0		0.26				0.95	
23		5.0			1.57	0.35	1.92		0		0.14	0.83	0.37	1.20	0.88	1.22
24		5.0			2.22	0.37	2.59		0		0.21	1.32	0.26	1.58	1.11	1.20
25		5.0			1.68	0.36	2.04		0		0.15	1.16	0.27	1.43	0.95	1.18
26		5.0			1.90	0.35	2.25		0		0.17	1.11	0.24	1.35	0.97	1.24
27		5.0			1.86	0.34	2.20		0		0.20	1.13	0.28	1.41	1.05	1.19
28		5.0							0		0.15				0	
29		5.0							0		0.09				0	
30		5.0			2.02	0.35	2.37		0		0.12	1.32	0.28	1.60	0	1.20
31		5.0			1.42	0.30	1.72		0		0.20	0.97	0.29	1.26	0	1.22

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 3.12: DISINFECTION PROFILE (OCT/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		5.0			1.85	0.36	2.21		0		0.52	1.00	0.36	1.36	0.89	1.04
2		5.0							0		0.72				0.99	
3		5.0							0		0.48				1.05	
4		5.0			1.68	0.36	2.04		0		0.36	1.17	0.26	1.43	0.91	
5		4.75			2.28	0.37	2.65		0		0.30	1.70	0.36	2.06	0.91	1.37
6		4.5							0		0.36				0.88	
7		4.5							0		0.32				0.81	
8		4.5							0		0.34				0.94	
9		4.5			1.49	0.38	1.87		0		0.23	1.06	0.26	1.32	0.91	
10		4.5			1.62	0.46	2.09		0		0.21	1.18	0.36	1.54	0.94	
11		4.5							0		0.32				0.79	
12		4.5			1.85	0.32	2.17		0		0.37	0.88	0.33	1.21	0.88	
13		4.5							0		0.15				0.92	
14		4.5							0		0.05				0.91	
15		4.5			1.77	0.39	2.16		0		0.05	1.18	0.31	1.49	0.94	
16		4.5			1.60	0.43	2.03		0		0.09	1.39	0.28	1.67	1.01	1.25
17		4.5			1.74	0.32	2.06		0		0.24	1.24	0.31	1.55	1.05	
18		4.5			1.56	0.41	1.97		0		0.10	1.13	0.31	1.44	1.25	1.25
19		4.5			1.40	0.44	1.84		0		0.09	0.90	0.36	1.26	0.90	1.18
20		4.5							0		0.35				0.94	
21		4.5							0		0.33				0.88	
22		4.5			0.85	0.26	1.11		0		0.24	1.40	0.42	1.82	1.01	1.22
23		4.5			1.54	0.38	1.92		0		0.19	1.10	0.30	1.40	1.16	1.21
24		4.5			1.46	0.43	1.89		0		0.19	1.10	0.28	1.38	0.96	1.19
25		4.5			1.51	0.36	1.87		0		0.15	1.08	0.33	1.41	0.86	
26		4.5							0		0.19				0.85	
27		4.5							0		0.36				0.84	
28		4.5							0		0.09				0.78	
29		4.5			1.52	0.38	1.90		0		0.16	1.22	0.29	1.51	0.90	1.18
30		4.5			1.69	0.39	2.08		0		0.25	1.25	0.29	1.54	0.76	1.16
31		4.5			1.82	0.37	2.19		0		0.38	1.08	0.28	1.36	0.91	1.18

Sources: Chlorine residuals, fluoride residuals - Laboratory Daily Log Books.

Chemical Dosages - Weekly Laboratory Report (average daily dose calculated from total amount of chemical used and total daily flow).

TABLE 4.0: WATER QUALITY SUMMARY (DRINKING WATER SURVEILLANCE PROGRAM)

GENERAL CHEMISTRY		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
GENERAL CHEMISTRY															
Alkalinity (mg/L)	R	95	83.2	87.4	80.2	71.4	76.2	83.0	74.8	79				0.2 (mg/L)	
	T	85.7	73.2	77.4	64.2	59.6	61.8	70.8	66.8	68.7					
Ammonium (Total) (mg/L)	R	0.05	0.05	0.05	0.05	0.05	0.05	0.20	0.05	0.113				0.05 (mg/L)	
	T	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.087					
Calcium (mg/L)	R													0.1 (mg/L)	
	T														
Chloride (mg/L)	R	6.65	5.0	5.89	4.8	2.4	3.8	8.2	5.2	6.3				0.2 (mg/L)	250 (mg/L)
	T	12.60	9.4	11.68	9.4	6.0	7.8	10.0	8.8	9.3					
Colour (TCU)	R	24.5	13.0	17.3				18.6	10.0	15.65				0.5 (TCU)	5 (TCU)
	T	11.0	4.5	6.9				8.2	5.5	6.3					
Conductivity (umho/cm)	R	223	197	207				213	200	204				0.01 (umho/cm)	
	T	231	203	213				214	205	209					
Field Chlorine (Combined)	R													0.1 (mg/L)	
	T														
Field Chlorine (Free)	R													0.1 (mg/L)	
	T														
Field Chlorine (Total)	R													0.1 (mg/L)	
	T														
Field pH	R													0.2	
	T														

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

GENERAL CHEMISTRY (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Field Temperature (^{o}C)	R														
	T														
Field Turbidity (FTU)	R														1 (FTU)
	T														
Fluoride (mg/L)	R	0.1	0.05	0.07	0.08	0.05	0.065	0.06	0.06	0.06				0.01 (mg/L)	2.4 (mg/L)
	T	1.01	0.06	0.72	1.61	0.86	1.12	1.28	0.05	0.81					
Hardness (mg/L)	R	100	93	97	91.0	84.3	86.9	94.6	92.2	92.9				0.5 (mg/L)	
	T	100	91.5	96.7	91.0	84.3	87.6	100.8	92.6	96.0					
Magnesium (mg/L)	R													0.05 (mg/L)	c
	T														
Nitrate (mg/L)	R	0.25	0.05	0.15	2.05	0.10	0.64	0.2	0.2	0.2				0.05 (mg/L)	10 (mg/L as N)
	T	0.2	0.05	0.10	5.50	0.05	1.48	0.2	0.05	0.12					
Nitrite (mg/L)	R	0.045	0.005	0.021	0.035	0.01	0.019	0.12	0.01	0.05				0.005 (mg/L)	1 (mg/L as N)
	T	0.015	0.005	0.009	0.005	0.005	0.005	0.01	0.005	0.0075					
Nitrogen Total Kjeldahl (mg/L)	R	0.4	0.4	0.4	0.5	0.3	0.45	0.5	0.3	0.4				0.1 (mg/L)	0.15 (mg/L) *
	T	0.4	0.2	0.3	0.6	0.3	0.43	0.3	0.25	0.28					
pH	R	8.26	7.71	8.07	7.99	7.7	7.84	8.11	7.71	7.93					
	T	8.10	7.25	7.77	7.2	7.05	7.12	7.45	7.24	7.30					
Phosphorus Filtered Reactive (mg/L)	R													0.01 (mg/L)	
	T														

GENERAL CHEMISTRY (cont'd.)		1986			1985			1984			198_			OWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Phosphorus (Total) (mg/L)	R	0.02	0.02	0.02	0.04	0.01	0.02	0.05	0.01	0.025				0.01 (mg/L)	
	T	0.02	0.02	0.02	0.04	0.01	0.02	0.04	0.02	0.0275					
Sodium (mg/L)	R				3.5	3.5	3.5							0.1 (mg/L)	
	T				3.5	3.5	3.5								
Total Solids (mg/L)	R	145	131	137	131	122	125	167	130	139				1 (mg/L)	
	T	150	133	140	137	125	130	137	131	134					
Turbidity (FTU)	R	1.21	0.48	0.84	1.50	0.32	0.74	1.72	0.62	1.23				0.01 (FTU)	1 (FTU)
	T	0.47	0.27	0.36	0.43	0.21	0.34	0.94	0.44	0.60					
METALS															
Aluminum (mg/L)	R	0.014	0.014	0.014	0.023	0.008	0.015	0.011	0.011	0.011				0.003 (mg/L)	0.10
	T	0.015	0.015	0.015	0.360	0.022	0.191	0.008	0.008	0.008					
Arsenic (mg/L)	R	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001				0.001 (mg/L)	0.05 (mg/L)
	T	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001					
Barium (mg/L)	R							0.022	0.022	0.022				0.001 (mg/L)	1 (mg/L)
	T							0.022	0.022	0.022					
Beryllium (mg/L)	R													0.001 (mg/L)	
	T														
Boron (mg/L)	R													0.02 (mg/L)	5 (mg/L)
	T														
Cadmium (mg/L)	R				0.002	0.002	0.002	0.002	0.002	0.002				0.0003 (mg/L)	0.005 (mg/L)
	T				0.002	0.002	0.002	0.002	0.002	0.002					

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

TABLE 4.0 (cont'd.)

METALS (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Chromium (mg/L)	R				0.001	0.001	0.001	0.01	0.01	0.01				0.001 (mg/L)	0.05 (mg/L)
	T				0.001	0.001	0.001	0.01	0.01	0.01					
Cobalt (mg/L)	R													0.001 (mg/L)	
	T														
Copper (mg/L)	R				0.003	0.003	0.003	0.005	0.005	0.005				0.001 (mg/L)	1 (mg/L)
	T				0.003	0.003	0.003	0.001	0.001	0.001					
Cyanide (mg/L)	R													0.001 (mg/L)	0.2 (mg/L)
	T														
Iron (mg/L)	R	0.072	0.072	0.072	0.07	0.033	0.054	0.13	0.02	0.065				0.002 (mg/L)	0.3 (mg/L)
	T	0.06	0.06	0.06	0.07	0.008	0.038	0.07	0.03	0.055					
Lead (mg/L)	R				0.003	0.003	0.003	0.003	0.003	0.003				0.003 (mg/L)	0.05 (mg/L)
	T				0.003	0.003	0.003	0.003	0.003	0.003					
Manganese (mg/L)	R				0.012	0.012	0.012	0.014	0.014	0.014				0.001 (mg/L)	0.05 (mg/L)
	T				0.004	0.004	0.004	0.004	0.004	0.004					
Molybdenum (mg/L)	R													0.001 (mg/L)	
	T														
Mercury (ug/L)	R													0.01 (ug/L)	1 (ug/L)
	T														
Nickel (mg/L)	R													0.002 (mg/L)	
	T														

TABLE 4.0 (cont'd.)

METALS (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Selenium (mg/L)	R				0.001	0.001	0.001							0.001 (mg/L)	0.01 (mg/L)
	T				0.001	0.001	0.001								
Strontium (mg/L)	R													0.001 (mg/L)	
	T														
Tin (no units available)	R														
	T														
Uranium (mg/L)	R													0.002 (mg/L)	0.02 (mg/L) t
	T														
Vanadium (mg/L)	R													0.001 (mg/L)	
	T														
Zinc (mg/L)	R				0.004	0.004	0.004	0.02	0.02	0.02				0.001 (mg/L)	5 (mg/L) h
	T				0.002	0.002	0.002	0.001	0.001	0.001					
PURGEABLES															
Benzene (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T														
Bromoform (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
Carbon Tetrachloride (ug/L)	R													1 (ug/L)	3 (ug/L) h
	T														
Chlorobenzene (ug/L)	R													1 (ug/L)	100-300 (ng/L) h*
	T														

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

TABLE 4.0 (cont'd.)

PURGEABLES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Chlorodibromomethane (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
Chloroform (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
1,2-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
1,3-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
1,4-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
Dichlorobromomethane (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T							3	3	3					
1,1-Dichloroethane (ug/L)	R													1 (ug/L)	
	T														
1,2-Dichloroethane (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T	215	215	215											
1,1-Dichloroethylene (ug/L)	R													1 (ug/L)	0.3 (ug/L) h
	T														
T,1,2-Dichloroethylene (ug/L)	R													1 (ug/L)	
	T														

TABLE 4.0 (cont'd.)

PURGEABLES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Dichloromethane (ug/L)	R T													5 (ug/L)	40 (ug/L) c
1,2-Dichloropropane (ug/L)	R T													1 (ug/L)	
Ethylbenzene (ug/L)	R T													1 (ug/L)	1400 (ug/L) e
Ethylene Dibromide (ug/L)	R T														
M-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
O-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
P-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
Toluene (ug/L)	R T													1 (ug/L)	100 (ug/L) c
1,1,2,2-Tetrachloroethane (ug/L)	R T													1 (ug/L)	1.7 (ug/L) e
Tetrachloroethane (ug/L)	R T													1 (ug/L)	10 (ug/L) h

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

TABLE 4.0 (cont'd.)

PURGEABLES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
1,1,1-Trichloroethane (ug/L)	R													1 (ug/L)	1000 (ug/L) c
	T														
1,1,2-Trichloroethane (ug/L)	R													1 (ug/L)	6 (ug/L) e
	T														
Trichloroethylene (ug/L)	R													1 (ug/L)	30 (ug/L) h
	T														
Total Trihalomethanes (ug/L)	R													3 (ug/L)	350 (ug/L) ++
	T	284	86	171	191	35	121	181	86	119					
Trifluorochloro-toluene (ug/L)	R													1 (ug/L)	
	T														
ORGANOCHLORINES															
Aldrin (ng/L)	R													1 (ng/L)	700 (ng/L) **
	T														
Alpha BHC (ng/L)	R													1 (ng/L)	700 (ng/L) c
	T														
Alpha Chlordane (ng/L)	R													2 (ng/L)	700 (ng/L) ***
	T														
Beta BHC (ng/L)	R													1 (ng/L)	300 (ng/L) c
	T														
Dieldrin (ng/L)	R													2 (ng/L)	700 (ng/L) **
	T														

TABLE 4.0 (cont'd.)

ORGANOCHLORINES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Endrin (ng/L)	R													4 (ng/L)	200 (ng/L)
	T														
Gamma Chlordane (ng/L)	R													2 (ng/L)	700 (ng/L) ***
	T														
Heptachlor Epoxide (ng/L)	R													1 (ng/L)	3000 (ng/L) +++
	T														
Heptachlor (ng/L)	R													1 (ng/L)	3000 (ng/L) +++
	T														
Hexachlorobenzene (ng/L)	R													1 (ng/L)	10 (ng/L) h
	T														
Hexachlorobutadiene (ug/L)	R														
	T														
Hexachloroethane (ng/L)	R													1 (ng/L)	19000 (ng/L) e
	T														
Lindane (ng/L)	R													1 (ng/L)	4000 (ng/L)
	T														
Methoxychlor (ng/L)	R													5 (ng/L)	100000 (ng/L)
	T														
Mirex (ng/L)	R													5 (ng/L)	
	T														

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

ORGANOCHLORINES (cont'd.)		1986			1985			1984			198_			OWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Octachlorostyrene (ng/L)	R T													1 (ng/L)	
O,P-DDT (ng/L)	R T													5 (ng/L)	30000 (ng/L) d
Oxychlordane (ng/L)	R T													2 (ng/L)	
PCB Total (ng/L)	R T													20 (ng/L)	3000 (ng/L) t
Pentachlorobenzene (ng/L)	R T													1 (ng/L)	74000 (ng/L) e
P,P-DDD (ng/L)	R T													5 (ng/L)	d
P,P-DDE (ng/L)	R T													1 (ng/L)	d
P,P-DDT (ng/L)	R T													5 (ng/L)	d
1,2,3,4-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	
1,2,3,5-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	

TABLE 4.0 (cont'd.)

ORGANOCHLORINES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
1,2,4,5-Tetra-chlorobenzene (ng/L)	R T													1 (ng/L)	38000 (ng/L) e
Thiodan I (ng/L)	R T													2 (ng/L)	74000 (ng/L) ea
Thiodan II (ng/L)	R T													4 (ng/L)	74000 (ng/L) ea
Thiodan Sulphate (ng/L)	R T													4 (ng/L)	
Toxaphene (no units available)	R T														
1,2,3-Trichlorobenzene (ng/L)	R T													5 (ng/L)	10000 (ng/L) y
1,2,4-Trichlorobenzene (ng/L)	R T													5 (ng/L)	15000 (ng/L) y
1,3,5-Trichlorobenzene (ng/L)	R T													5 (ng/L)	10000 (ng/L) y
2,3,6-Trichlorotoluene (ng/L)	R T													5 (ng/L)	
2,4,5-Trichlorotoluene (ng/L)	R T													5 (ng/L)	10000 (ng/L) g

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

TABLE 4.0 (cont'd.)

TRIAZINES		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R T													5 (ng/L)	
Alachlor (ng/L)	R T														
Ametrine (ng/L)	R T													50 (ng/L)	
Atratone (ng/L)	R T														
Atrazine (ng/L)	R T													50 (ng/L)	46000 (ng/L)
Bladex (ng/L)	R T													100 (ng/L)	10000 (ng/L)
Metolachlor (ng/L)	R T														
Prometone (ng/L)	R T													50 (ng/L)	
Prometryne (ng/L)	R T													50 (ng/L)	1000 (ng/L)
Propazine (ng/L)	R T													50 (ng/L)	

TRIAZINES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Sencor	R													100	
(ng/L)	T													(ng/L)	
Simazine	R													50	10000
(ng/L)	T													(ng/L)	(ng/L) !
SPECIAL PESTICIDES															
2,4-D	R													100	100000
(ng/L)	T													(ng/L)	(ng/L)
2,4-D Butyric Acid	R													200	18000
(ng/L)	T													(ng/L)	(ng/L) !
Dicamba	R													100	87000
(ng/L)	T													(ng/L)	(ng/L) !
Pentachlorophenol	R													50	10000
(ng/L)	T													(ng/L)	(ng/L) h
Picloram	R													100	
(ng/L)	T													(ng/L)	
2,4-D Propionic Acid	R													100	
(ng/L)	T													(ng/L)	
Silvex	R													50	10000
(ng/L)	T													(ng/L)	(ng/L)
2,4,5-T	R													50	
(ng/L)	T													(ng/L)	

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

SPECIAL PESTICIDES (cont'd.)		1986			1985			1984			198_			OWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
2,3,4,5-Tetra-chlorophenol (ng/L)	R T													50 (ng/L)	
2,3,5,6-Tetra-chlorophenol (ng/L)	R T													50 (ng/L)	
2,3,4-Trichlorophenol (ng/L)	R T													100 (ng/L)	
2,4,5-Trichlorophenol (ng/L)	R T													50 (ng/L)	
2,4,6-Trichlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R T													50 (ng/L)	14000 (ng/L)
Dichlorovos (ng/L)	R T														
Dursban (ng/L)	R T														
Ethion (ng/L)	R T														
Guthion (ng/L)	R T														

TABLE 4.0 (cont'd)

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Malathion (ng/L)	R														
	T														
Methylparathion (ng/L)	R													50 (ng/L)	7000 (ng/l)
	T														
Methyltrithion (ng/L)	R														
	T														
Mevinphos (ng/L)	R														
	T														
Parathion (ng/L)	R													50 (ng/L)	35000 (ng/L)
	T														
Phorbate (ng/L)	R														
	T														
Reldan (ng/L)	R														
	T														
Ronnel (ng/L)	R														
	T														
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R													0.1 (ug/L)	34000 (ug/L) e
	T														

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

TABLE 4 0 (cont'd)

MASS SPEC. (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
N-Dichloromethylene- Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/l)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

TABLE 4.0 (cont'd)

MASS SPEC. (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R														
Total Coliform BKGD	R														
Fecal Coliform MF (count/100 mL)	R													0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R													0	500
Treated Water:															
Present/Absent Test	T														
Total Coliform Background MF (count/100 mL)	T													0	OWDO Bacti
Fecal Coliform MF (count/100 mL)	T													0	OWDO Bacti

Note: Maximum, minimum and average values calculated from monthly grab sample values reported on the 1-year summary sheets. Sampling was not conducted for all twelve months.

Additional notes at end of table.

TABLE 4.0 (cont'd.)

BACTERIA (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Treated Water (cont'd.)															
Standard Plate Count MF (count/100 mL)	T														
If Present/Absent Test Positive:															
Coliform P/A	R														
	T														
Fecal Coliform P/A	R														
	T														
E. Coli P/A	R														
	T														
Aromonas P/A	R														
	T														
Staph. Aureus P/A	R														
	T														

TABLE 4.0 - FOOTNOTES

1 = see individual footnotes for agency of guideline origin
c = California State Department of Health action level
d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e = USEPA ambient guideline
ea = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep = USEPA proposed maximum contaminant level for drinking water
g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h = World Health Organization (WHO) guideline
h* = World Health Organization (WHO) odour threshold
mg/L = milligrams per litre, parts per million (ppm)
ng/L = nanograms per litre, parts per trillion (ppt)
Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria
R = raw water
T = treated drinking water
t = ODWO interim maximum acceptable concentration (IMAC)
ug/L = micrograms per litre, parts per billon (ppb)
y = New York State (taste and odour) proposed drinking water guideline
++ = total trihalomethanes
+++ = combined total: heptachlor and heptachlor epoxide
* = if other than DWSP detection limit
** = total of aldrin and dieldrin
*** = chlordane is a mixture of alpha and gamma isomers
! = Ministry of the Environment and Health and Welfare Canada (IMAC)
- = no quantifiable result
G = ODWO suggested guideline

TABLE 4.1: ONE-YEAR WATER QUALITY SUMMARY (DRINKING WATER SURVEILLANCE PROGRAM)

GENERAL CHEMISTRY		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
GENERAL CHEMISTRY															
Alkalinity (mg/L)	R		83.2			95			84.7			86.7		0.2 (mg/L)	
	T		83.2			85.7			73.3			77.4			
Ammonium (Total) (mg/L)	R		0.05			0.05			0.10			0.05		0.05 (mg/L)	
	T		0.05			0.05			0.05			0.05			
Calcium (mg/L)	R													0.1 (mg/L)	
	T														
Chloride (mg/L)	R		5.0			6.65			5.95			5.95		0.2 (mg/L)	250 (mg/L)
	T		9.4			12.20			12.60			12.50			
Colour (TCU)	R		24.5			14.5			13.0			17.0		0.5 (TCU)	5 (TCU)
	T		11.0			5.0			4.5			7.0			
Conductivity (umho/cm)	R		208			223			197			201.0		0.01 (umho/cm)	
	T		210			231			203			207.0			
Field Chlorine (Combined)	R													0.1 (mg/L)	
	T														
Field Chlorine (Free)	R													0.1 (mg/L)	
	T														
Field Chlorine (Total)	R													0.1 (mg/L)	
	T														
Field pH	R													0.2	
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.1 (cont'd.)

GENERAL CHEMISTRY (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Field Temperature (^{o}C)	R														
	T														
Field Turbidity (FTU)	R														1 (FTU)
	T														
Fluoride (mg/L)	R		0.10			0.05			0.07			0.07		0.01 (mg/L)	2.4 (mg/L)
	T		1.01			0.94			0.88			0.06			
Hardness (mg/L)	R		100			100			93.0			95.0		0.5 (mg/L)	
	T		99.7			100			91.5			95.5			
Magnesium (mg/L)	R													0.05 (mg/L)	
	T														c
Nitrate (mg/L)	R		0.25			0.05			0.15			0.15		0.05 (mg/L)	10 (mg/L as N)
	T		0.20			0.05			0.10			0.05			
Nitrite (mg/L)	R		0.045			0.025			0.01			0.005		0.005 (mg/L)	1 (mg/L as N)
	T		0.010			0.015			0.005			0.005			
Nitrogen Total Kjeldahl (mg/L)	R								0.40			0.40		0.1 (mg/L)	0.15 (mg/L) *
	T								0.20			0.40			
pH	R		7.71			8.08			8.23			8.26			
	T		7.25			7.68			8.10			8.05			
Phosphorus Filtered Reactive (mg/L)	R													0.01 (mg/L)	
	T														

TABLE 4.1 (cont'd.)

GENERAL CHEMISTRY (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Phosphorus (Total) (mg/L)	R					0.020			0.020			0.02		0.01 (mg/L)	
	T					0.02			0.020			0.02			
Sodium (mg/L)	R													0.1 (mg/L)	
	T														
Total Solids (mg/L)	R		13.5			147			131			133		1 (mg/L)	
	T		137			150			133			139			
Turbidity (FTU)	R		0.48			0.89			0.78			1.21		0.01 (FTU)	1 (FTU)
	T		0.33			0.47			0.38			0.27			
METALS															
Aluminum (mg/L)	R		0.014											0.003 (mg/L)	G
	T		0.015												
Arsenic (mg/L)	R					0.001								0.001 (mg/L)	0.05 (mg/L)
	T					0.001									
Barium (mg/L)	R													0.001 (mg/L)	1 (mg/L)
	T														
Beryllium (mg/L)	R													0.001 (mg/L)	
	T														
Boron (mg/L)	R													0.02 (mg/L)	5 (mg/L)
	T														
Cadmium (mg/L)	R													0.0003 (mg/L)	0.005 (mg/L)
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 1 (cont'd)

METALS (cont'd.)		1986												DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Chromium (mg/L)	R													0.001 (mg/L)	0.05 (mg/L)
	T														
Cobalt (mg/L)	R													0.001 (mg/L)	
	T														
Copper (mg/L)	R													0.001 (mg/L)	1 (mg/L)
	T														
Cyanide (mg/L)	R													0.001 (mg/L)	0.2 (mg/L)
	T														
Iron (mg/L)	R		0.072											0.002 (mg/L)	0.3 (mg/L)
	T		0.060												
Lead (mg/L)	R													0.003 (mg/L)	0.05 (mg/L)
	T														
Manganese (mg/L)	R													0.001 (mg/L)	0.05 (mg/L)
	T														
Molybdenum (mg/L)	R													0.001 (mg/L)	
	T														
Mercury (ug/L)	R													0.01 (ug/L)	1 (ug/L)
	T														
Nickel (mg/L)	R													0.002 (mg/L)	
	T														

TABLE 4.1 (cont'd.)

METALS (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Selenium (mg/L)	R T													0.001 (mg/L)	0.01 (mg/L)
Strontium (mg/L)	R T													0.001 (mg/L)	
Tin (no units available)	R T														
Uranium (mg/L)	R T													0.002 (mg/L)	0.02 (mg/L) t
Vanadium (mg/L)	R T													0.001 (mg/L)	
Zinc (mg/L)	R T													0.001 (mg/L)	5 (mg/L) h
PURGEABLES															
Benzene (ug/L)	R T													1 (ug/L)	10 (ug/L) h
Bromoform (ug/L)	R T													1 (ug/L)	350 (ug/L) ++
Carbon Tetrachloride (ug/L)	R T													1 (ug/L)	3 (ug/L) h
Chlorobenzene (ug/L)	R T													1 (ug/L)	100-300 (ng/L) h*

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 1 (cont'd)

PURGEABLES (cont'd.)		1986												OWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Chlorodibromomethane	R													1	350
(ug/L)	T													(ug/L)	(ug/L) ++
Chloroform	R													1	350
(ug/L)	T													(ug/L)	(ug/L) ++
1,2-Dichlorobenzene	R													1	400
(ug/L)	T													(ug/L)	(ug/L) e
1,3-Dichlorobenzene	R													1	400
(ug/L)	T													(ug/L)	(ug/L) e
1,4-Dichlorobenzene	R													1	400
(ug/L)	T													(ug/L)	(ug/L) e
Dichlorobromomethane	R													1	350
(ug/L)	T													(ug/L)	(ug/L) ++
1,1-Dichloroethane	R													1	
(ug/L)	T													(ug/L)	
1,2-Dichloroethane	R													1	10
(ug/L)	T													(ug/L)	(ug/L) h
1,1-Dichloroethylene	R													1	0.3
(ug/L)	T													(ug/L)	(ug/L) h
1,1,2-Dichloroethylene	R													1	
(ug/L)	T													(ug/L)	

TABLE 4 1 (cont'd.)

PURGEABLES (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Dichloromethane (ug/L)	R T													5 (ug/L)	40 (ug/L) c
1,2-Dichloropropane (ug/L)	R T													1 (ug/L)	
Ethylbenzene (ug/L)	R T													1 (ug/L)	1400 (ug/L) e
Ethylene Dibromide (ug/L)	R T														
M-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
O-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
P-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
Toluene (ug/L)	R T													1 (ug/L)	100 (ug/L) c
1,1,2,2-Tetrachloroethane (ug/L)	R T													1 (ug/L)	1.7 (ug/L) e
Tetrachloroethane (ug/L)	R T													1 (ug/L)	10 (ug/L) h

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.1 (cont'd.)

PURGEABLES (cont'd.)		1986												OWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1,1,1-Trichloroethane (ug/L)	R													1 (ug/L)	1000 (ug/L) c
	T														
1,1,2-Trichloroethane (ug/L)	R													1 (ug/L)	6 (ug/L) e
	T														
Trichloroethylene (ug/L)	R													1 (ug/L)	30 (ug/L) h
	T														
Total Trihalomethanes (ug/L)	R													3 (ug/L)	350 (ug/L) ++
	T	165	142	121	179	194	208	--	167	--	284	165	86		
Trifluorochlorotoluene (ug/L)	R													1 (ug/L)	
	T														
ORGANOCHLORINES															
Aldrin (ng/L)	R													1 (ng/L)	700 (ng/L) **
	T														
Alpha BHC (ng/L)	R													1 (ng/L)	700 (ng/L) c
	T														
Alpha Chlordane (ng/L)	R													2 (ng/L)	700 (ng/L) ***
	T														
Beta BHC (ng/L)	R													1 (ng/L)	300 (ng/L) c
	T														
Dieldrin (ng/L)	R													2 (ng/L)	700 (ng/L) **
	T														

TABLE 4.1 (cont'd.)

ORGANOCHLORINES (cont'd.)		1986												OWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Endrin (ng/L)	R T													4 (ng/L)	200 (ng/L)
Gamma Chlordane (ng/L)	R T													2 (ng/L)	700 (ng/L) ***
Heptachlor Epoxide (ng/L)	R T													1 (ng/L)	3000 (ng/L) +++
Heptachlor (ng/L)	R T													1 (ng/L)	3000 (ng/L) +++
Hexachlorobenzene (ng/L)	R T													1 (ng/L)	10 (ng/L) h
Hexachlorobutadiene (ug/L)	R T														
Hexachloroethane (ng/L)	R T													1 (ng/L)	19000 (ng/L) e
Lindane (ng/L)	R T													1 (ng/L)	4000 (ng/L)
Methoxychlor (ng/L)	R T													5 (ng/L)	100000 (ng/L)
Mirex (ng/L)	R T													5 (ng/L)	

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 1 (cont'd)

ORGANOCHLORINES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Octachlorostyrene (ng/L)	R T													1 (ng/L)	
O,P-DDT (ng/L)	R T													5 (ng/L)	30000 (ng/L) d
Oxychlordane (ng/L)	R T													2 (ng/L)	
PCB Total (ng/L)	R T													20 (ng/L)	3000 (ng/L) t
Pentachlorobenzene (ng/L)	R T													1 (ng/L)	74000 (ng/L) e
P,P-DDD (ng/L)	R T													5 (ng/L)	d
P,P-DDE (ng/L)	R T													1 (ng/L)	d
P,P-DDT (ng/L)	R T													5 (ng/L)	d
1,2,3,4-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	
1,2,3,5-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	

TABLE 4.1 (cont'd.)

ORGANOCHLORINES (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1,2,4,5-Tetra-chlorobenzene (ng/L)	R													1 (ng/L)	38000 (ng/L) e
	T														
Thiodan I (ng/L)	R													2 (ng/L)	74000 (ng/L) ea
	T														
Thiodan II (ng/L)	R													4 (ng/L)	74000 (ng/L) ea
	T														
Thiodan Sulphate (ng/L)	R													4 (ng/L)	
	T														
Toxaphene (no units available)	R														
	T														
1,2,3-Trichlorobenzene (ng/L)	R													5 (ng/L)	10000 (ng/L) y
	T														
1,2,4-Trichlorobenzene (ng/L)	R													5 (ng/L)	15000 (ng/L) y
	T														
1,3,5-Trichlorobenzene (ng/L)	R													5 (ng/L)	10000 (ng/L) y
	T														
2,3,6-Trichlorotoluene (ng/L)	R													5 (ng/L)	
	T														
2,4,5-Trichlorotoluene (ng/L)	R													5 (ng/L)	10000 (ng/L) g
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 1 (cont'd.)

TRIAZINES		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R													5 (ng/L)	
	T														
Alachlor (ng/L)	R														
	T														
Ametrine (ng/L)	R													50 (ng/L)	
	T														
Atratone (ng/L)	R														
	T														
Atrazine (ng/L)	R													50 (ng/L)	46000 (ng/L) !
	T														
Bladex (ng/L)	R													100 (ng/L)	10000 (ng/L) !
	T														
Metolachlor (ng/L)	R														
	T														
Prometone (ng/L)	R													50 (ng/L)	
	T														
Prometryne (ng/L)	R													50 (ng/L)	1000 (ng/L) !
	T														
Propazine (ng/L)	R													50 (ng/L)	
	T														

TABLE 4.1 (cont'd.)

TRIAZINES (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE^1
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Sencor (ng/L)	R T													100 (ng/L)	
Simazine (ng/L)	R T													50 (ng/L)	10000 (ng/L) !
SPECIAL PESTICIDES															
2,4-D (ng/L)	R T													100 (ng/L)	100000 (ng/L)
2,4-D Butyric Acid (ng/L)	R T													200 (ng/L)	18000 (ng/L) !
Dicamba (ng/L)	R T													100 (ng/L)	87000 (ng/L) !
Pentachlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
Picloram (ng/L)	R T													100 (ng/L)	
2,4-D Propionic Acid (ng/L)	R T													100 (ng/L)	
Silvex (ng/L)	R T													50 (ng/L)	10000 (ng/L)
2,4,5-T (ng/L)	R T													50 (ng/L)	

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.1 (cont'd.)

SPECIAL PESTICIDES (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
2,3,4,5-Tetra-chlorophenol (ng/L)	R T													50 (ng/L)	
2,3,5,6-Tetra-chlorophenol (ng/L)	R T													50 (ng/L)	
2,3,4-Trichlorophenol (ng/L)	R T													100 (ng/L)	
2,4,5-Trichlorophenol (ng/L)	R T													50 (ng/L)	
2,4,6-Trichlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R T													50 (ng/L)	14000 (ng/L)
Dichlorovos (ng/L)	R T														
Dursban (ng/L)	R T														
Ethion (ng/L)	R T														
Guthion (ng/L)	R T														

TABLE 4 1 (cont'd.)

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Malathion (ng/L)	R														
	T														
Methylparathion (ng/L)	R													50 (ng/L)	7000 (ng/L)
	T														
Methyltrithion (ng/L)	R														
	T														
Mevinphos (ng/L)	R														
	T														
Parathion (ng/L)	R													50 (ng/L)	35000 (ng/L)
	T														
Phorbate (ng/L)	R														
	T														
Reldan (ng/L)	R														
	T														
Ronnel (ng/L)	R														
	T														
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R													0.1 (ug/L)	34000 (ug/L) e
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.1 (cont'd.)

MASS SPEC. (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

MASS SPEC. (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R														
Total Coliform BKGD	R														
Fecal Coliform MF (count/100 mL)	R													0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R													0	500
Treated Water:															
Present/Absent Test	T														
Total Coliform Background MF (count/100 mL)	T													0	OWDO Bacti
Fecal Coliform MF (count/100 mL)	T													0	OWDO Bacti

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.1 (cont'd.)

BACTERIA (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Treated Water (cont'd.) Standard Plate Count MF (count/100 mL)	T														
If Present/Absent Test Positive: Coliform P/A	R T														
Fecal Coliform P/A	R T														
E. Coli P/A	R T														
Aromonas P/A	R T														
Staph. Aureus P/A	R T														

* If other than DWSP detection limit

TABLE 4.1 - FOOTNOTES

1 = see individual footnotes for agency of guideline origin
c = California State Department of Health action level
d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e = USEPA ambient guideline
ea = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers
ep = USEPA proposed maximum contaminant level for drinking water
g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h = World Health Organization (WHO) guideline
h* = World Health Organization (WHO) odour threshold
mg/L = milligrams per litre, parts per million (ppm)
ng/L = nanograms per litre, parts per trillion (ppt)
Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria
R = raw water
T = treated drinking water
t = ODWO interim maximum acceptable concentration (IMAC)
ug/L = micrograms per litre, parts per billon (ppb)
y = New York State (taste and odour) proposed drinking water guideline
++ = total trihalomethanes
+++ = combined total: heptachlor and heptachlor epoxide
* = if other than DWSP detection limit
** = total of aldrin and dieldrin
*** = chlordane is a mixture of alpha and gamma isomers
! = Ministry of the Environment and Health and Welfare Canada (IMAC)
- = no quantifiable result
G = ODWO suggested guideline

TABLE 4 2 ONE-YEAR WATER QUALITY SUMMARY (DRINKING WATER SURVEILLANCE PROGRAM)

GENERAL CHEMISTRY		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
GENERAL CHEMISTRY															
Alkalinity	R		71.4			80.2			78.2			75.2		0.2	
(mg/L)	T		64.2			60.2			63.4			59.6		(mg/L)	
Ammonium (Total)	R		0.05			0.05			0.05			0.05		0.05	
(mg/L)	T		0.05			0.05			0.05			0.05		(mg/L)	
Calcium	R													0.1	
(mg/L)	T													(mg/L)	
Chloride	R		4.8			2.4			4.2			4.0		0.2	250
(mg/L)	T		9.4			6.0			9.0			7.0		(mg/L)	(mg/L)
Colour	R		19.5			19.0			12.5			17.5		0.5	5
(TCU)	T		10.0			3.0			3.5			3.0		(TCU)	(TCU)
Conductivity	R		188			201			192			187		0.01	
(umho/cm)	T		192			210			200			198		(umho/cm)	
Field Chlorine	R													0.1	
(Combined)	T													(mg/L)	
Field Chlorine	R													0.1	
(Free)	T													(mg/L)	
Field Chlorine	R													0.1	
(Total)	T													(mg/L)	
Field pH	R													0.2	
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

GENERAL CHEMISTRY (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Field Temperature (^{o}C)	R														
	T														
Field Turbidity (FTU)	R														1 (FTU)
	T														
Fluoride (mg/L)	R		0.08			0.06			0.07			0.05		0.01 (mg/L)	2.4 (mg/L)
	T		1.61			0.86			1.06			0.94			
Hardness (mg/L)	R		84.3			91.0			88.1			84.3		0.5 (mg/L)	
	T		84.3			91.0			88.9			86.3			
Magnesium (mg/L)	R													0.05 (mg/L)	c
	T														
Nitrate (mg/L)	R		0.20			0.20			0.10			2.05		0.05 (mg/L)	10 (mg/L as N)
	T		0.15			0.20			0.05			5.50			
Nitrite (mg/L)	R		0.015			0.015			0.035			0.01		0.005 (mg/L)	1 (mg/L as N)
	T		0.005			0.005			0.005			0.005			
Nitrogen Total Kjeldahl (mg/L)	R		0.30			0.50			0.50			0.50		0.1 (mg/L)	0.15 (mg/L) *
	T		0.30			0.60			0.50			0.30			
pH	R		7.7			7.84			7.81			7.99			
	T		7.2			7.05			7.16			7.07			
Phosphorus Filtered Reactive (mg/L)	R													0.01 (mg/L)	
	T														

TABLE 4 2 (cont'd)

GENERAL CHEMISTRY (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Phosphorus (Total) (mg/L)	R		0.04			0.02			0.01			0.01		0.01 (mg/L)	
	T		0.02			0.04			0.01			0.01			
Sodium (mg/L)	R			3.5										0.1 (mg/L)	
	T			3.5											
Total Solids (mg/L)	R		122			131			125			122		1 (mg/L)	
	T		125			137			130			129			
Turbidity (FTU)	R		0.32			1.50			0.47			0.65		0.01 (FTU)	1 (FTU)
	T		0.21			0.39			0.43			0.34			
METALS															
Aluminum (mg/L)	R			0.023					0.008					0.003 (mg/L)	G
	T			0.022					0.360						
Arsenic (mg/L)	R			< 0.001										0.001 (mg/L)	0.05 (mg/L)
	T			< 0.001											
Barium (mg/L)	R			0.022										0.001 (mg/L)	1 (mg/L)
	T			0.044											
Beryllium (mg/L)	R													0.001 (mg/L)	
	T														
Boron (mg/L)	R													0.02 (mg/L)	5 (mg/L)
	T														
Cadmium (mg/L)	R			0.0002										0.0003 (mg/L)	0.005 (mg/L)
	T			0.0002											

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 2 (cont'd)

METALS (cont'd.)		1985												DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Chromium (mg/L)	R			0.001										0.001 (mg/L)	0.05 (mg/L)
	T			0.001											
Cobalt (mg/L)	R													0.001 (mg/L)	
	T														
Copper (mg/L)	R			0.003										0.001 (mg/L)	1 (mg/L)
	T			0.003											
Cyanide (mg/L)	R													0.001 (mg/L)	0.2 (mg/L)
	T														
Iron (mg/L)	R		0.07	0.061		0.05			0.033					0.002 (mg/L)	0.3 (mg/L)
	T		0.07	0.055		0.02			0.008						
Lead (mg/L)	R			0.003										0.003 (mg/L)	0.05 (mg/L)
	T			0.003											
Manganese (mg/L)	R			0.012										0.001 (mg/L)	0.05 (mg/L)
	T			0.004											
Molybdenum (mg/L)	R													0.001 (mg/L)	
	T														
Mercury (ug/L)	R													0.01 (ug/L)	1 (ug/L)
	T														
Nickel (mg/L)	R													0.002 (mg/L)	
	T														

TABLE 4.2 (cont'd)

METALS (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Selenium	R			0.001										0.001	0.01
(mg/L)	T			0.001										(mg/L)	(mg/L)
Strontium	R													0.001	
(mg/L)	T													(mg/L)	
Tin	R														
(no units available)	T														
Uranium	R													0.002	0.02
(mg/L)	T													(mg/L)	(mg/L) t
Vanadium	R													0.001	
(mg/L)	T													(mg/L)	
Zinc	R			0.004										0.001	5
(mg/L)	T			0.002										(mg/L)	(mg/L) h
PURGEABLES															
Benzene	R													1	10
(ug/L)	T													(ug/L)	(ug/L) h
Bromoform	R													1	350
(ug/L)	T													(ug/L)	(ug/L) ++
Carbon Tetrachloride	R													1	3
(ug/L)	T													(ug/L)	(ug/L) h
Chlorobenzene	R													1	100-300
(ug/L)	T													(ug/L)	(ng/L) h*

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.2 (cont'd.)

PURGEABLES (cont'd.)		1985												DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Chlorodibromomethane (ug/L)	R T													1 (ug/L)	350 (ug/L) ++
Chloroform (ug/L)	R T													1 (ug/L)	350 (ug/L) ++
1,2-Dichlorobenzene (ug/L)	R T													1 (ug/L)	400 (ug/L) e
1,3-Dichlorobenzene (ug/L)	R T													1 (ug/L)	400 (ug/L) e
1,4-Dichlorobenzene (ug/L)	R T													1 (ug/L)	400 (ug/L) e
Dichlorobromomethane (ug/L)	R T													1 (ug/L)	350 (ug/L) ++
1,1-Dichloroethane (ug/L)	R T													1 (ug/L)	
1,2-Dichloroethane (ug/L)	R T													1 (ug/L)	10 (ug/L) h
1,1-Dichloroethylene (ug/L)	R T													1 (ug/L)	0.3 (ug/L) h
T,1,2-Dichloroethylene (ug/L)	R T													1 (ug/L)	

PURGEABLES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Dichloromethane (ug/L)	R T													5 (ug/L)	40 (ug/L) c
1,2-Dichloropropane (ug/L)	R T													1 (ug/L)	
Ethylbenzene (ug/L)	R T													1 (ug/L)	1400 (ug/L) e
Ethylene Dibromide (ug/L)	R T														
M-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
O-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
P-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
Toluene (ug/L)	R T													1 (ug/L)	100 (ug/L) c
1,1,2,2-Tetrachloroethane (ug/L)	R T													1 (ug/L)	1.7 (ug/L) e
Tetrachloroethane (ug/L)	R T													1 (ug/L)	10 (ug/L) h

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 2 (cont'd)

PURGEABLES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1,1,1-Trichloroethane (ug/L)	R													1 (ug/L)	1000 (ug/L) c
	T														
1,1,2-Trichloroethane (ug/L)	R													1 (ug/L)	6 (ug/L) e
	T														
Trichloroethylene (ug/L)	R								--		--			1 (ug/L)	30 (ug/L) h
	T														
Total Trihalomethanes (ug/L)	R													3 (ug/L)	350 (ug/L) ++
	T	108	102	108	96	113	132	163	168	191	136	101	35		
Trifluorochloro-toluene (ug/L)	R													1 (ug/L)	
	T														
ORGANOCHLORINES															
Aldrin (ng/L)	R													1 (ng/L)	700 (ng/L) **
	T														
Alpha BHC (ng/L)	R													1 (ng/L)	700 (ng/L) c
	T														
Alpha Chlordane (ng/L)	R													2 (ng/L)	700 (ng/L) ***
	T														
Beta BHC (ng/L)	R													1 (ng/L)	300 (ng/L) c
	T														
Dieldrin (ng/L)	R													2 (ng/L)	700 (ng/L) **
	T														

TABLE 4.2 (cont'd)

ORGANOCHLORINES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Endrin (ng/L)	R T													4 (ng/L)	200 (ng/L)
Gamma Chlordane (ng/L)	R T													2 (ng/L)	700 (ng/L) ***
Heptachlor Epoxide (ng/L)	R T													1 (ng/L)	3000 (ng/L) +++
Heptachlor (ng/L)	R T													1 (ng/L)	3000 (ng/L) +++
Hexachlorobenzene (ng/L)	R T													1 (ng/L)	10 (ng/L) h
Hexachlorobutadiene (ug/L)	R T														
Hexachloroethane (ng/L)	R T													1 (ng/L)	19000 (ng/L) e
Lindane (ng/L)	R T													1 (ng/L)	4000 (ng/L)
Methoxychlor (ng/L)	R T													5 (ng/L)	100000 (ng/L)
Mirex (ng/L)	R T													5 (ng/L)	

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.2 (cont'd.)

ORGANOCHLORINES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Octachlorostyrene (ng/L)	R T													1 (ng/L)	
O,P-DDT (ng/L)	R T													5 (ng/L)	30000 (ng/L) d
Oxychlordane (ng/L)	R T													2 (ng/L)	
PCB Total (ng/L)	R T													20 (ng/L)	3000 (ng/L) t
Pentachlorobenzene (ng/L)	R T													1 (ng/L)	74000 (ng/L) e
P,P-DDD (ng/L)	R T													5 (ng/L)	d
P,P-DDE (ng/L)	R T													1 (ng/L)	d
P,P-DDT (ng/L)	R T													5 (ng/L)	d
1,2,3,4-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	
1,2,3,5-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	

TABLE 4.2 (cont'd.)

ORGANOCHLORINES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1,2,4,5-Tetra-chlorobenzene (ng/L)	R													1 (ng/L)	38000 (ng/L) e
	T														
Thiodan I (ng/L)	R													2 (ng/L)	74000 (ng/L) ea
	T														
Thiodan II (ng/L)	R													4 (ng/L)	74000 (ng/L) ea
	T														
Thiodan Sulphate (ng/L)	R													4 (ng/L)	
	T														
Toxaphene (no units available)	R														
	T														
1,2,3-Trichlorobenzene (ng/L)	R													5 (ng/L)	10000 (ng/L) y
	T														
1,2,4-Trichlorobenzene (ng/L)	R													5 (ng/L)	15000 (ng/L) y
	T														
1,3,5-Trichlorobenzene (ng/L)	R													5 (ng/L)	10000 (ng/L) y
	T														
2,3,6-Trichlorotoluene (ng/L)	R													5 (ng/L)	
	T														
2,4,5-Trichlorotoluene (ng/L)	R													5 (ng/L)	10000 (ng/L) g
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.2 (cont'd.)

TRIAZINES		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R													5 (ng/L)	
	T														
Alachlor (ng/L)	R														
	T														
Ametrine (ng/L)	R													50 (ng/L)	
	T														
Atratone (ng/L)	R														
	T														
Atrazine (ng/L)	R													50 (ng/L)	46000 (ng/L) !
	T														
Bladex (ng/L)	R													100 (ng/L)	10000 (ng/L) !
	T														
Metolachlor (ng/L)	R														
	T														
Prometone (ng/L)	R													50 (ng/L)	
	T														
Prometryne (ng/L)	R													50 (ng/L)	1000 (ng/L) !
	T														
Propazine (ng/L)	R													50 (ng/L)	
	T														

TABLE 4 2 (cont'd)

TRIAZINES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Sencor (ng/L)	R T													100 (ng/L)	
Simazine (ng/L)	R T													50 (ng/L)	10000 (ng/L) !
SPECIAL PESTICIDES															
2,4-D (ng/L)	R T													100 (ng/L)	100000 (ng/L)
2,4-D Butyric Acid (ng/L)	R T													200 (ng/L)	18000 (ng/L) !
Dicamba (ng/L)	R T													100 (ng/L)	87000 (ng/L) !
Pentachlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
Picloram (ng/L)	R T													100 (ng/L)	
2,4-D Propionic Acid (ng/L)	R T													100 (ng/L)	
Silvex (ng/L)	R T													50 (ng/L)	10000 (ng/L)
2,4,5-T (ng/L)	R T													50 (ng/L)	

NOTE: Values reported are once a month grab sample analysis.

Additional notes at end of table.

SPECIAL PESTICIDES (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
2,3,4,5-Tetrachlorophenol (ng/L)	R T													50 (ng/L)	
2,3,5,6-Tetrachlorophenol (ng/L)	R T													50 (ng/L)	
2,3,4-Trichlorophenol (ng/L)	R T													100 (ng/L)	
2,4,5-Trichlorophenol (ng/L)	R T													50 (ng/L)	
2,4,6-Trichlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R T													50 (ng/L)	14000 (ng/L)
Dichlorovos (ng/L)	R T														
Dursban (ng/L)	R T														
Ethion (ng/L)	R T														
Guthion (ng/L)	R T														

TABLE 4.2 (cont'd)

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Malathion (ng/L)	R														
	T														
Methylparathion (ng/L)	R													50 (ng/L)	7000 (ng/L)
	T														
Methyltrithion (ng/L)	R														
	T														
Mevinphos (ng/L)	R														
	T														
Parathion (ng/L)	R													50 (ng/L)	35000 (ng/L)
	T														
Phorbate (ng/L)	R														
	T														
Reldan (ng/L)	R														
	T														
Ronnel (ng/L)	R														
	T														
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R													0.1 (ug/L)	34000 (ug/L) e
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

MASS SPEC. (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

TABLE 4.2 (cont'd)

MASS SPEC. (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R														
Total Coliform BKGD	R														
Fecal Coliform MF (count/100 mL)	R													0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R													0	500
Treated Water:															
Present/Absent Test	T														
Total Coliform Background MF (count/100 mL)	T													0	OWDO Bact1
Fecal Coliform MF (count/100 mL)	T													0	OWDO Bact1

NOTE: Values reported are once a month grab sample analysis.

Additional notes at end of table.

TABLE 4.2 (cont'd)

BACTERIA (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Treated Water (cont'd.)															
Standard Plate Count MF (count/100 mL)	T														
If Present/Absent Test Positive:															
Coliform P/A	R T														
Fecal Coliform P/A	R T														
E. Coli P/A	R T														
Aromonas P/A	R T														
Staph. Aureus P/A	R T														

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* If other than DWSP detection limit

TABLE 4.2 - Footnotes

1 = see individual footnotes for agency of guideline origin
c = California State Department of Health action level
d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e = USEPA ambient guideline
ea = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep = USEPA proposed maximum contaminant level for drinking water
g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h = World Health Organization (WHO) guideline
h* = World Health Organization (WHO) odour threshold
mg/L = milligrams per litre, parts per million (ppm)
ng/L = nanograms per litre, parts per trillion (ppt)
Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria
R = raw water
T = treated drinking water
t = ODWO interim maximum acceptable concentration (IMAC)
ug/L = micrograms per litre, parts per billon (ppb)
y = New York State (taste and odour) proposed drinking water guideline
++ = total trihalomethanes
+++ = combined total: heptachlor and heptachlor epoxide
* = if other than DWSP detection limit
** = total of aldrin and dieldrin
*** = chlordane is a mixture of alpha and gamma isomers
! = Ministry of the Environment and Health and Welfare Canada (IMAC)
- = no quantifiable result
G = ODWO suggested guideline

TABLE 4.3 ONE-YEAR WATER QUALITY SUMMARY (DRINKING WATER SURVEILLANCE PROGRAM)

GENERAL CHEMISTRY		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
GENERAL CHEMISTRY															
Alkalinity	R			74.8		79.6			78.6			83.0		0.2	
(mg/L)	T			67.2		66.8			70.0			70.8		(mg/L)	
Ammonium (Total)	R			0.1		0.1			0.05			0.20		0.05	
(mg/L)	T			0.1		0.1			0.05			0.10		(mg/L)	
Calcium	R													0.1	
(mg/L)	T													(mg/L)	
Chloride	R			5.8		5.2			8.2			6.0		0.2	250
(mg/L)	T			8.8		8.8			10.0			9.6		(mg/L)	(mg/L)
Colour	R			18.6		18.0			10.0			16.0		0.5	5
(TCU)	T			8.2		6.5			5.0			5.5		(TCU)	(TCU)
Conductivity	R			202		200			200			213		0.01	
(umho/cm)	T			205		210			208			214		(umho/cm)	
Field Chlorine	R													0.1	
(Combined)	T													(mg/L)	
Field Chlorine	R													0.1	
(Free)	T													(mg/L)	
Field Chlorine	R													0.1	
(Total)	T													(mg/L)	
Field pH	R													0.2	
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.3 (cont'd.)

GENERAL CHEMISTRY (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Field Temperature (^{o}C)	R														
	T														
Field Turbidity (FTU)	R														1 (FTU)
	T														
Fluoride (mg/L)	R			0.06		0.06			0.06			0.06		0.01 (mg/L)	2.4 (mg/L)
	T			0.05		0.70			1.21			1.28			
Hardness (mg/L)	R			92.2		92.7			92.3			94.6		0.5 (mg/L)	
	T			92.6		96.4			100.8			94.2			
Magnesium (mg/L)	R													0.05 (mg/L)	c
	T														
Nitrate (mg/L)	R			0.2					--			--		0.05 (mg/L)	10 (mg/L as N)
	T			0.2					0.05			0.10			
Nitrite (mg/L)	R			0.12		0.02			0.05			0.01		0.005 (mg/L)	1 (mg/L as N)
	T			0.01		0.01			0.005			0.005			
Nitrogen Total Kjeldahl (mg/L)	R			0.40		0.50			0.30					0.1 (mg/L)	0.15 (mg/L) *
	T			0.30		0.30			0.25						
pH	R			7.88		8.11			7.71			8.02			
	T			7.45		7.24			7.25			7.25			
Phosphorus Filtered Reactive (mg/L)	R													0.01 (mg/L)	
	T														

GENERAL CHEMISTRY (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Phosphorus (Total)	R			0.02		0.05			0.01			0.02		0.01	
(mg/L)	T			0.03		0.04			0.02			0.02		(mg/L)	
Sodium	R													0.1	
(mg/L)	T													(mg/L)	
Total Solids	R			130		130			130			167		1	
(mg/L)	T			131		137			135			134		(mg/L)	
Turbidity	R			0.62		0.99			1.72			1.58		0.01	1
(FTU)	T			0.44		0.48			0.53			0.94		(FTU)	(FTU)
METALS															
Aluminum	R			0.011										0.003	
(mg/L)	T			0.008										(mg/L)	G
Arsenic	R			0.001										0.001	0.05
(mg/L)	T			0.001										(mg/L)	(mg/L)
Barium	R			0.022										0.001	1
(mg/L)	T			0.022										(mg/L)	(mg/L)
Beryllium	R													0.001	
(mg/L)	T													(mg/L)	
Boron	R													0.02	5
(mg/L)	T													(mg/L)	(mg/L)
Cadmium	R			0.0002										0.0003	0.005
(mg/L)	T			0.0002										(mg/L)	(mg/L)

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4 3 (cont'd)

METALS (cont'd.)		1984												DWSP DETECTION LIMIT*	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Chromium	R			0.01										0.001	0.05
(mg/L)	T			0.01										(mg/L)	(mg/L)
Cobalt	R													0.001	
(mg/L)	T													(mg/L)	
Copper	R			0.005										0.001	1
(mg/L)	T			0.001										(mg/L)	(mg/L)
Cyanide	R													0.001	0.2
(mg/L)	T													(mg/L)	(mg/L)
Iron	R			0.13		0.07			0.02			0.04		0.002	0.3
(mg/L)	T			0.07		0.07			0.05			0.03		(mg/L)	(mg/L)
Lead	R			0.003										0.003	0.05
(mg/L)	T			0.003										(mg/L)	(mg/L)
Manganese	R			0.014										0.001	0.05
(mg/L)	T			0.014										(mg/L)	(mg/L)
Molybdenum	R													0.001	
(mg/L)	T													(mg/L)	
Mercury	R													0.01	1
(ug/L)	T													(ug/L)	(ug/L)
Nickel	R													0.002	
(mg/L)	T													(mg/L)	

METALS (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Selenium (mg/L)	R			0.001										0.001 (mg/L)	0.01 (mg/L)
	T			0.001											
Strontium (mg/L)	R													0.001 (mg/L)	
	T														
Tin (no units available)	R														
	T														
Uranium (mg/L)	R													0.002 (mg/L)	0.02 (mg/L) t
	T														
Vanadium (mg/L)	R													0.001 (mg/L)	
	T														
Zinc (mg/L)	R			0.02										0.001 (mg/L)	5 (mg/L) h
	T			0.001											
PURGEABLES															
Benzene (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T														
Bromoform (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
Carbon Tetrachloride (ug/L)	R													1 (ug/L)	3 (ug/L) h
	T														
Chlorobenzene (ug/L)	R													1 (ug/L)	100-300 (ng/L) h*
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

PURGEABLES (cont'd.)		1984												DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Chlorodibromomethane (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
Chloroform (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
1,2-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
1,3-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
1,4-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
Dichlorobromomethane (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T					3									
1,1-Dichloroethane (ug/L)	R													1 (ug/L)	
	T														
1,2-Dichloroethane (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T														
1,1-Dichloroethylene (ug/L)	R													1 (ug/L)	0.3 (ug/L) h
	T														
T,1,2-Dichloroethylene (ug/L)	R													1 (ug/L)	
	T														

TABLE 4.3 (cont'd)

PURGEABLES (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Dichloromethane (ug/L)	R													5 (ug/L)	40 (ug/L) c
	T														
1,2-Dichloropropane (ug/L)	R													1 (ug/L)	
	T														
Ethylbenzene (ug/L)	R													1 (ug/L)	1400 (ug/L) e
	T														
Ethylene Dibromide (ug/L)	R														
	T														
M-Xylene (ug/L)	R													1 (ug/L)	620 (ug/L) c
	T														
O-Xylene (ug/L)	R													1 (ug/L)	620 (ug/L) c
	T														
P-Xylene (ug/L)	R													1 (ug/L)	620 (ug/L) c
	T														
Toluene (ug/L)	R													1 (ug/L)	100 (ug/L) c
	T														
1,1,2,2-Tetrachloroethane (ug/L)	R													1 (ug/L)	1.7 (ug/L) e
	T														
Tetrachloroethane (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T														

NOTE: Values reported are once a month grab sample analysis.

Additional notes at end of table.

PURGEABLES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
1,1,1-Trichloroethane (ug/l)	R													1 (ug/l)	1000 (ug/L) c
	T														
1,1,2-Trichloroethane (ug/l)	R													1 (ug/L)	6 (ug/L) e
	T														
Trichloroethylene (ug/L)	R													1 (ug/L)	30 (ug/l) h
	T														
Total Trihalomethanes (ug/L)	R													3 (ug/L)	350 (ug/L) ++
	T	--	86	108	92	130	110	76	136	171	181	111	103		
Trifluorochloro toluene (ug/l)	R													1 (ug/l)	
	T														
ORGANOCHLORINES															
Aldrin (ng/L)	R													1 (ng/l)	700 (ng/L) **
	T														
Alpha BHC (ng/l)	R													1 (ng/L)	700 (ng/L) c
	T														
Alpha Chlordane (ng/l)	R													2 (ng/L)	700 (ng/L) ***
	T														
Beta BHC (ng/l)	R													1 (ng/l)	300 (ng/l) c
	T														
Dieldrin (ng/l)	R													2 (ng/L)	700 (ng/l) **
	T														

TABLE 4 3 (cont'd.)

ORGANOCHLORINES (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Endrin (ng/L)	R													4 (ng/L)	200 (ng/L)
	T														
Gamma Chlordane (ng/L)	R													2 (ng/L)	700 (ng/L) ***
	T														
Heptachlor Epoxide (ng/L)	R													1 (ng/L)	3000 (ng/L) +++
	T														
Heptachlor (ng/L)	R													1 (ng/L)	3000 (ng/L) +++
	T														
Hexachlorobenzene (ng/L)	R													1 (ng/L)	10 (ng/L) h
	T														
Hexachlorobutadiene (ug/L)	R														
	T														
Hexachloroethane (ng/L)	R													1 (ng/L)	19000 (ng/L) e
	T														
Lindane (ng/L)	R													1 (ng/L)	4000 (ng/L)
	T														
Methoxychlor (ng/L)	R													5 (ng/L)	100000 (ng/L)
	T														
Mirex (ng/L)	R													5 (ng/L)	
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.3 (cont'd.)

ORGANOCHLORINES (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Octachlorostyrene (ng/L)	R T													1 (ng/L)	
O,P-DDT (ng/L)	R T													5 (ng/L)	30000 (ng/L) d
Oxychlordane (ng/L)	R T													2 (ng/L)	
PCB Total (ng/L)	R T													20 (ng/L)	3000 (ng/L) t
Pentachlorobenzene (ng/L)	R T													1 (ng/L)	74000 (ng/L) e
P,P-DDD (ng/L)	R T													5 (ng/L)	d
P,P-DDE (ng/L)	R T													1 (ng/L)	d
P,P-DDT (ng/L)	R T													5 (ng/L)	d
1,2,3,4-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	
1,2,3,5-Tetrachlorobenzene (ng/L)	R T													1 (ng/L)	

TABLE 4.3 (cont'd.)

ORGANOCHLORINES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
1,2,4,5-Tetra-chlorobenzene (ng/L)	R													1 (ng/L)	38000 (ng/L) e
	T														
Thiodan I (ng/L)	R													2 (ng/L)	74000 (ng/L) ea
	T														
Thiodan II (ng/L)	R													4 (ng/L)	74000 (ng/L) ea
	T														
Thiodan Sulphate (ng/L)	R													4 (ng/L)	
	T														
Toxaphene (no units available)	R														
	T														
1,2,3-Trichlorobenzene (ng/L)	R													5 (ng/L)	10000 (ng/L) y
	T														
1,2,4-Trichlorobenzene (ng/L)	R													5 (ng/L)	15000 (ng/L) y
	T														
1,3,5-Trichlorobenzene (ng/L)	R													5 (ng/L)	10000 (ng/L) y
	T														
2,3,6-Trichlorotoluene (ng/L)	R													5 (ng/L)	
	T														
2,4,5-Trichlorotoluene (ng/L)	R													5 (ng/L)	10000 (ng/L) g
	T														

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.3 (cont'd.)

TRIAZINES		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
TRIAZINES															
2,6,A-Trichlorotoluene	R													5	
(ng/L)	T													(ng/L)	
Alachlor	R														
(ng/L)	T														
Ametrine	R													50	
(ng/L)	T													(ng/L)	
Atratone	R														
(ng/L)	T														
Atrazine	R													50	46000
(ng/L)	T													(ng/L)	(ng/L) !
Bladex	R													100	10000
(ng/L)	T													(ng/L)	(ng/L) !
Metolachlor	R														
(ng/L)	T														
Prometone	R													50	
(ng/L)	T													(ng/L)	
Prometryne	R													50	1000
(ng/L)	T													(ng/L)	(ng/L) !
Propazine	R													50	
(ng/L)	T													(ng/L)	

TRIAZINES (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Sencor	R													100	
(ng/L)	T													(ng/L)	
Simazine	R													50	10000
(ng/L)	T													(ng/L)	(ng/L) !
SPECIAL PESTICIDES															
2,4-D	R													100	100000
(ng/L)	T													(ng/L)	(ng/L)
2,4-D Butyric Acid	R													200	18000
(ng/L)	T													(ng/L)	(ng/L) !
Dicamba	R													100	87000
(ng/L)	T													(ng/L)	(ng/L) !
Pentachlorophenol	R													50	10000
(ng/L)	T													(ng/L)	(ng/L) h
Picloram	R													100	
(ng/L)	T													(ng/L)	
2,4-D Propionic Acid	R													100	
(ng/L)	T													(ng/L)	
Silvex	R													50	10000
(ng/L)	T													(ng/L)	(ng/L)
2,4,5-T	R													50	
(ng/L)	T													(ng/L)	

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.3 (cont'd.)

SPECIAL PESTICIDES (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
2,3,4,5-Tetra-chlorophenol (ng/L)	R T													50 (ng/L)	
2,3,5,6-Tetra-chlorophenol (ng/L)	R T													50 (ng/L)	
2,3,4-Trichlorophenol (ng/L)	R T													100 (ng/L)	
2,4,5-Trichlorophenol (ng/L)	R T													50 (ng/L)	
2,4,6-Trichlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R T													50 (ng/L)	14000 (ng/L)
Dichlorovos (ng/L)	R T														
Dursban (ng/L)	R T														
Ethion (ng/L)	R T														
Guthion (ng/L)	R T														

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Malathion (ng/L)	R T														
Methylparathion (ng/L)	R T													50 (ng/L)	7000 (ng/L)
Methyltrithion (ng/L)	R T														
Mevinphos (ng/L)	R T														
Parathion (ng/L)	R T													50 (ng/L)	35000 (ng/L)
Phorbate (ng/L)	R T														
Reldan (ng/L)	R T														
Ronnel (ng/L)	R T														
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R T													0.1 (ug/L)	34000 (ug/L) e

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

MASS SPEC. (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

TABLE 4.3 (cont'd.)

MASS SPEC. (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R														
Total Coliform BKGD	R														
Fecal Coliform MF (count/100 mL)	R													0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R													0	500
Treated Water:															
Present/Absent Test	T														
Total Coliform Background MF (count/100 mL)	T													0	OWDO Bacti
Fecal Coliform MF (count/100 mL)	T													0	OWDO Bacti

NOTE: Values reported are once a month grab sample analysis.
Additional notes at end of table.

TABLE 4.3 (cont'd.)

BACTERIA (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Treated Water (cont'd.) Standard Plate Count MF (count/100 mL)	T														
If Present/Absent Test Positive: Coliform P/A	R T														
Fecal Coliform P/A	R T														
E. Coli P/A	R T														
Aromonas P/A	R T														
Staph. Aureus P/A	R T														

* If other than DWSP detection limit

TABLE 4.3 - FOOTNOTES

1 = see individual footnotes for agency of guideline origin
c = California State Department of Health action level
d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e = USEPA ambient guideline
ea = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep = USEPA proposed maximum contaminant level for drinking water
g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h = World Health Organization (WHO) guideline
h* = World Health Organization (WHO) odour threshold
mg/L = milligrams per litre, parts per million (ppm)
ng/L = nanograms per litre, parts per trillion (ppt)
Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria
R = raw water
T = treated drinking water
t = ODWO interim maximum acceptable concentration (IMAC)
ug/L = micrograms per litre, parts per billon (ppb)
y = New York State (taste and odour) proposed drinking water guideline
++ = total trihalomethanes
+++ = combined total: heptachlor and heptachlor epoxide
* = if other than DWSP detection limit
** = total of aldrin and dieldrin
*** = chlordane is a mixture of alpha and gamma isomers
! = Ministry of the Environment and Health and Welfare Canada (IMAC)
- = no quantifiable result
G = ODWO suggested guideline

TABLE 5.0: ALGAE COUNT

MONTH	COUNT	1986	1985	1984	
JAN	Max.	57	315	142	
	Min.	34	112	20	
	Avg.	42	213	79	
	No. Tests	4	4	4	
FEB	Max.	70	155	145	
	Min.	32	42	54	
	Avg.	53	94	92	
	No. Tests	4	4	4	
MAR	Max.	141	161	89	
	Min.	47	109	31	
	Avg.	87	132	60	
	No. Tests	3	4	3	
APR	Max.	434	643	115	
	Min.	188	248	115	
	Avg.	303	497	115	
	No. Tests	4	4	1	
MAY	Max.	644	893		
	Min.	467	146		
	Avg.	545	569		
	No. Tests	4	5		
JUN	Max.	410	589	518	
	Min.	213	216	219	
	Avg.	298	378	400	
	No. Tests	4	4	4	

NOTE: All units ASU/ml.

Tests conducted at Peterborough WTP.

TABLE 5.0 (cont'd.)

MONTH	COUNT	1986	1985	1984	
JUL	Max.	274	675	421	
	Min.	164	407	294	
	Avg.	239	495	347	
	No. Tests	5	4	5	
AUG	Max.	1237	1197	1148	
	Min.	925	639	472	
	Avg.	1037	851	675	
	No. Tests	3	3	4	
SEP	Max.	1315	1068	2411	
	Min.	564	815	1608	
	Avg.	959	900	1955	
	No. Tests	5	3	4	
OCT	Max.	1119	1110	1083	
	Min.	660	506	615	
	Avg.	905	782	772	
	No. Tests	4	4	3	
NOV	Max.	503	904	1013	
	Min.	394	452	349	
	Avg.	452	591	663	
	No. Tests	4	4	4	
DEC	Max.	467	245	446	
	Min.	81	245	270	
	Avg.	232	245	358	
	No. Tests	4	1	2	

NOTE: All units ASU/ml.

Tests conducted at Peterborough WTP.

TABLE 6 0. BACTERIOLOGICAL TESTING (1986)

Page 1 of 1

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R		4	13			6	10	1						
	T	17					17								
FEB	R	1	5	10			7	9							
	T	16					16								
MAR	R		1	11	1		5	2	4	2					
	T	13					13								
APR	R		1	15			7	6	2	1					
	T	16					16								
MAY	R			14	3		1	4	6	7					
	T	17					17								
JUN	R			14	5				1	18					
	T	19					19								
JUL	R			18	5					23					
	T	23					23								
AUG	R			17	6					23					
	T	23					23								
SEP	R			8	11					18	1				
	T	19					19								
OCT	R			5	11			1	1	14					
	T	16					16								
NOV	R			17	1			10	5	3					
	T	18					18								
DEC	R			22				19	3						
	T	22					22								

NOTE: All results are for 100 mL samples.

R = Raw; T = Treated

Tests conducted by provincial health lab in Peterborough.

TABLE 6.1: BACTERIOLOGICAL TESTING (1985)

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R		2	14	2		3	11	4						
	T	18					18								
FEB	R		2	13	1			8	4	4					
	T	16					16								
MAR	R			14	3			6	3	8					
	T	17					17								
APR	R			15			3	7	5						
	T	15					15								
MAY	R		1	17				5	7	6					
	T	18					18								
JUN	R			12	4			1		15					
	T	16					16								
JUL	R			13	4				1	16					
	T	17					17								
AUG	R			2	15					17					
	T	17					17								
SEP	R			13	3					15	1				
	T	16					16								
OCT	R			13	2			1	1	13					
	T	15					15								
NOV	R			14	2			7	2	7					
	T	16					16								
DEC	R		1	11	3			8	2	5					
	T	15					15								

NOTE: All results are for 100 mL samples.

R = Raw; T = Treated

Tests conducted by provincial health lab in Peterborough.

TABLE 6.2 BACTERIOLOGICAL TESTING (1984)

Page 1 of 1

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R			15	4			13	2	4					
	T	19					19								
FEB	R			16				12		4					
	T	16					16								
MAR	R			18				11	5	2					
	T	18					18								
APR	R		2	13	2		1	4	1	6					
	T	17					17								
MAY	R		1	14	1		1	2	4	9					
	T	16					16								
JUN	R			13	2				3	13					
	T	14					14								
JUL	R														
	T	16					16								
AUG	R			4	4					8					
	T	19					19								
SEP	R			9	4					13					
	T	13					13								
OCT	R			14	2				2	14					
	T	16					16								
NOV	R			9	7			4	2	10					
	T	16					16								
DEC	R		3	11	2			7	4	5					
	T	16					16								

NOTE: All results are for 100 mL samples.

R = Raw; T = Treated

Tests conducted by provincial health lab in Peterborough.

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVE EXCEEDENCES INCLUDING ALUMINUM (TREATED WATER AT PLANT)

Page 1 of 1

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
30 Apr. 84	Aluminum	0.340 mg/L	0.1 mg/L
20 Aug. 84	Aluminum	0.27 mg/L	0.1 mg/L
12 Nov. 84	Aluminum	0.53 mg/L	0.1 mg/L
26 Aug. 85	Aluminum	0.360 mg/L	0.1 mg/L
Nov. 85	Aluminum	0.34 mg/L	0.1 mg/L
06 May 86	Aluminum	0.3 mg/L	0.1 mg/L
06 May 86	Aluminum	0.25 mg/L	0.1 mg/L
16 May 86	Aluminum	0.2 mg/L	0.1 mg/L
15 May 86	Aluminum	0.3 mg/L	0.1 mg/L
02 June 86	Aluminum	0.11 mg/L	0.1 mg/L
02 June 86	Aluminum	0.19 mg/L	0.1 mg/L
09 June 86	Aluminum	0.14 mg/L	0.1 mg/L
09 June 86	Aluminum	0.18 mg/L	0.1 mg/L
27 June 86	Aluminum	0.15 mg/L	0.1 mg/L
30 June 86	Aluminum	0.25 mg/L	0.1 mg/L
23 July 86	Aluminum	0.19 mg/L	0.1 mg/L
25 July 86	Aluminum	0.28 mg/L	0.1 mg/L
25 July 86	Aluminum	0.17 mg/L	0.1 mg/L
25 July 86	Aluminum	0.21 mg/L	0.1 mg/L
25 July 86	Aluminum	0.19 mg/L	0.1 mg/L
29 July 86	Aluminum	0.20 mg/L	0.1 mg/L
29 July 86	Aluminum	0.19 mg/L	0.1 mg/L
27 June 86	Aluminum	0.22 mg/L	0.1 mg/L
02 July 86	Aluminum	0.21 mg/L	0.1 mg/L
16 May 86	Aluminum	0.11 mg/L	0.1 mg/L
18 Aug. 86	Aluminum	0.18 mg/L	0.1 mg/L
18 Aug. 86	Aluminum	0.14 mg/L	0.1 mg/L
21 Aug. 86	Aluminum	0.20 mg/L	0.1 mg/L
04 Sep. 86	Aluminum	0.16 mg/L	0.1 mg/L
10 Nov. 86	Aluminum	0.35 mg/L	0.1 mg/L
11 Nov. 86	Aluminum	0.28 mg/L	0.1 mg/L
20 Nov. 86	Aluminum	0,20 mg/L	0.1 mg/L
12 Dec. 86	Aluminum	0.28 mg/L	0.1 mg/L
Apr. 85	Aluminum	0.36 mg/L	0.1 mg/L

Source: Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

APPENDIX B

FILTER BACKWASHING GUIDELINES AND PROCEDURE

FILTER BACKWASHING PROCEDURE
PETERBOROUGH WATER FILTRATION PLANT

Backwashing Filters

1. Close Influent Valve.
2. When water level goes below top of troughs, close the effluent and open the drain.
3. Open Back Wash Valve.
4. Open Agitator Valve.
5. Turn backwash pump switch to low rate.
6. After about 3-5 min., shut off agitators, go to high rate.
7. When backwash water becomes reasonably clear, shut off backwash pump.
8. When water is no longer rising, close drain.
9. Close Backwash Valve.
10. Open Influent Valve.
11. Put Filter Rate on Auto.

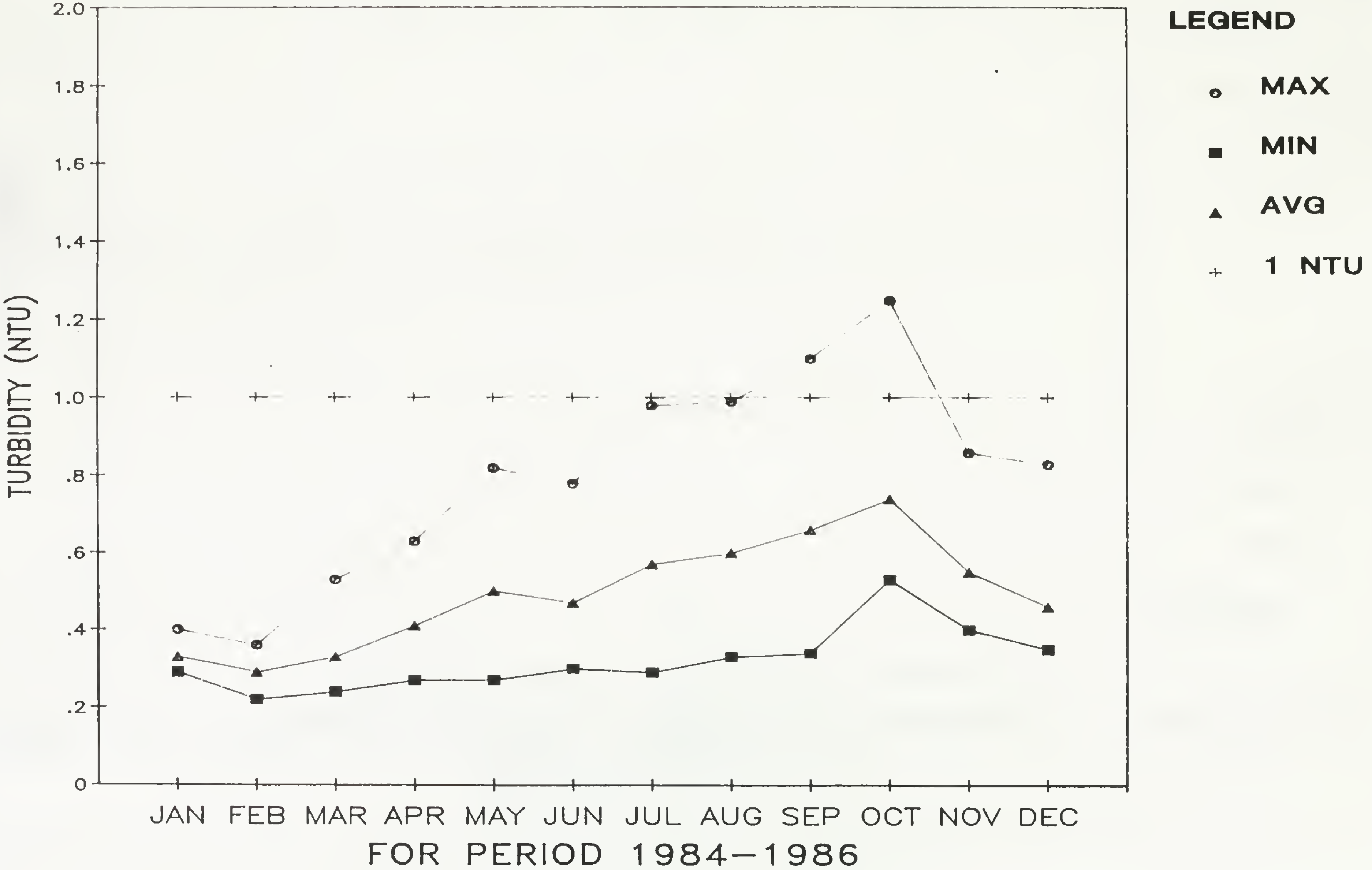
APPENDIX C

GRAPHICAL TURBIDITY DATA

PETERBOROUGH WTP

FIG. 1: COMPOSITE PROFILE

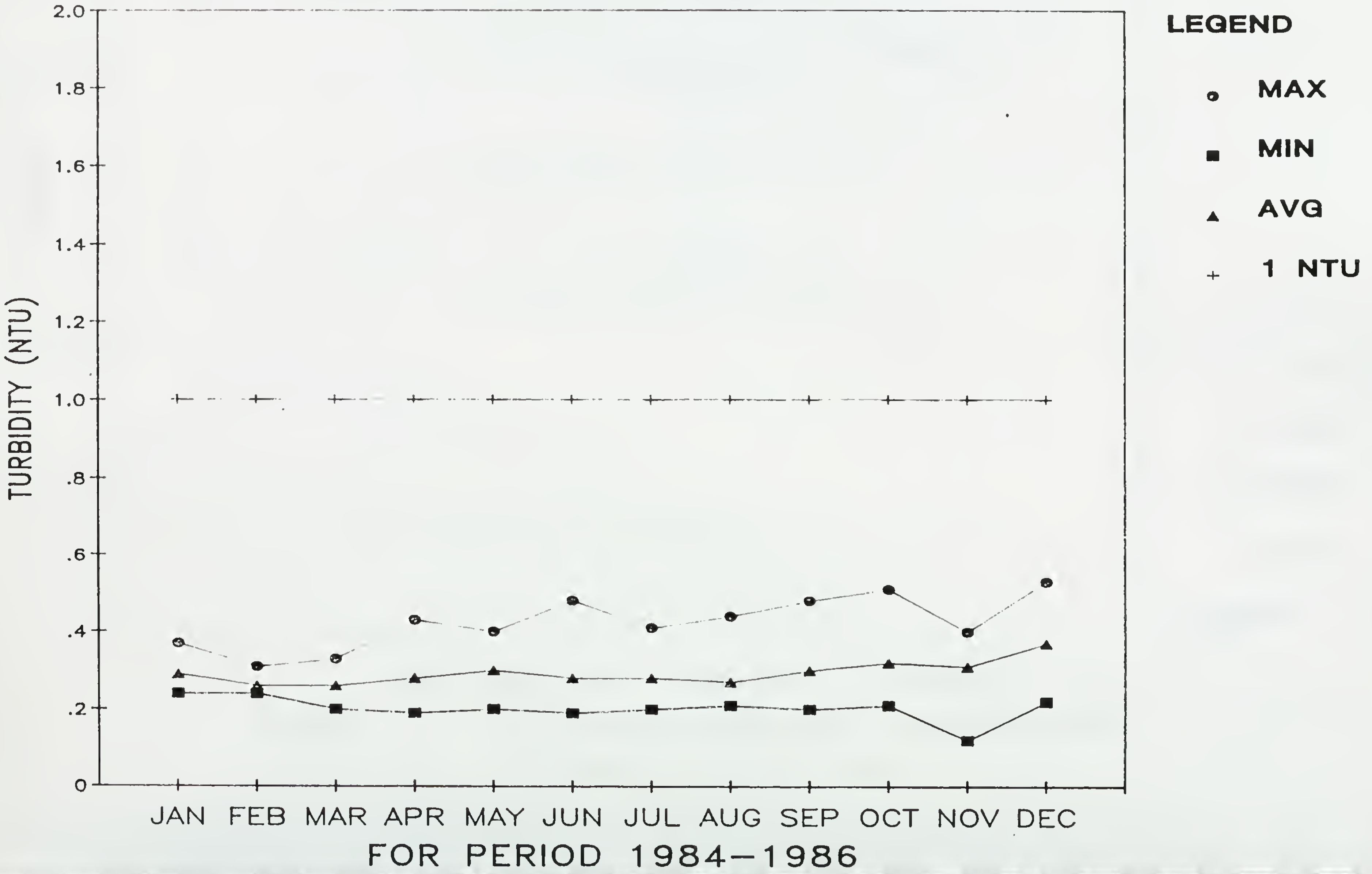
RAW WATER TURBIDITY RANGES



PETERBOROUGH WTP

FIG. 2: COMPOSITE PERFORMANCE PROFILE

TREATED WATER TURBIDITY RANGES



APPENDIX D

JAR TESTING

PETERBOROUGH WTP

Jar Test Procedure

The jar test procedure that was used for tests 1 and 2 carried out on Peterborough raw water was as follows:

1. Two hundred mL sample used.
2. Two minutes fast mix, i.e. 200 rpm.
3. Thirty minutes flocculation, i.e. 140 rpm.
4. Thirty minutes settling time.
5. Filtration through a Whatman glass microfibre filter, followed by 1.2 µm filter.

The test procedure for Tests 3 to 5 was as follows:

1. 1 Litre samples used.
2. Adjust pH if applicable (test 5).
3. Two minutes flash mix (>100 rpm).
4. Thirty minutes flocculation (30 rpm).
5. Thirty minutes settling time.
6. Filter through a 1.2 µm membrane filter by vacuum filtration.

LABORATORY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
9 Apr/87	MOE Water Plant Optimization Study - Peterborough WTP	380.71

SAMPLE NO. & DESCRIPTION

No. 1 - Typical raw water sample collected 1 April 1987.

No. 2 - Typical raw water sample collected 10 Sept. 1987.

PARAMETERS	SAMPLE NO. 1	SAMPLE NO. 2	SAMPLE NO.	SAMPLE NO.
pH	8.08	7.88		
Colour (HCU)	15-20	5-10		
Turbidity (NTU)	1.4	0.88		
Alkalinity (mg/L as $CaCO_3$)	92	90		
Hardness (mg/L as $CaCO_3$)	110	104		
Iron (mg/L)				
Manganese (mg/L)				

COMMENTS

CONDUCTED BY

REVIEWED BY

TEST NO. 1

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
9 Apr/87	MOE - Water Plant Optimization Study Peterborough WTP	380.71

TEST DESCRIPTION

Removal of Turbidity and Colour with Alum

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	WATER QUALITY AFTER TREATMENT					
	Alum			pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	
1									
2	5		4	8.08	0.30	5-10	91	110	
3	10		4	8.08	0.24	5	90	110	
4	15		3	8.08	0.20	5	86	110	
5	20		3	8.08	0.22	5	84	108	
6	25		2	8.08	0.20	<5	80	107	
7	30		1-2	8.06	0.16	<5	78	106	
RAW, UNTREATED				8.08	1.2	15-20	92	110	

SAMPLE TEMPERATURE Start: 7.5°C Finish: 16.5°C

COMMENTS

Floc Rating:

1 - very good
2 - good
3 - poor
4 - very poor
5 - no floc

CONDUCTED BY

REVIEWED BY

TEST NO. 2

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
13 Apr/87	MOE - Water Plant Optimization Study Peterborough WTP	380.71

TEST DESCRIPTION

Removal of Turbidity and Colour with Polyaluminum Chloride

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	WATER QUALITY AFTER TREATMENT					
	(1) PACl			pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	
1									
2	3		4	7.98	0.18	5-10	90	107	
3	5		2	7.98	0.16	5-10	90	108	
4	7.5		2-3	7.98	0.18	5-10	90	108	
5	10		3	7.98	0.17	10	90	106	
6	12.5		3	7.97	0.19	10-15	89	108	
7	15		3	7.97	0.22	10	89	108	
RAW, UNTREATED				8.08	1.2	15-20	92	110	

SAMPLE TEMPERATURE Start: 7.5°C Finish: 14.0°C

COMMENTS

Floc Rating:

1 - very good
2 - good
3 - poor
4 - very poor
5 - no floc

(1) Sternson polyaluminum chloride added from a 10 mg/mL solution.

CONDUCTED BY

REVIEWED BY

TEST NO. 3

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
14 Sep/87	MOE - Water Plant Optimization Study Peterborough WTP	380.71

TEST DESCRIPTION

Removal of Turbidity and Colour with Alum or Polyaluminum Chloride.
Aluminum Residuals Tested - 1 Litre Jar Tests, Raw Water #2.

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	(1) WATER QUALITY AFTER TREATMENT					
	(2) Alum	(3) PACl		pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	Al (mg/L)
raw									
2	15		2-3	7.69	0.14	<5	81	104	0.21
3	25		2	7.65	0.12	<5	77	102	0.15
4	30		1-2	7.64	0.14	<5	80	100	0.14
5		3	4	7.86	0.20	<5	88	104	0.21
6		5	4	7.95	0.18	<5	91	104	0.26
7		7.5	4	8.01	0.14	<5	90	102	0.31
RAW, UNTREATED				7.88	0.88	5-10	90	104	

SAMPLE TEMPERATURE Start: 24.0°C Finish: 24.0°C

COMMENTS

(1) Treatment Steps: Alum or Polyaluminum Chloride added; stirred at greater than 100 rpm for 2 minutes, 30 rpm for 30 minutes; settled for 30 minutes and filtered through a 1.2 μm membrane filter by vacuum filtration.

(2) Commercial grade equivalent $Al_2 (SO_4)_3 \cdot 14H_2$ added from a 10 mg/mL solution.

(3) Sternson polyaluminum chloride added from a 10 mg/L solution.

Floc Rating:

1 - very good	4 - very poor
2 - good	5 - no floc
3 - poor	

CONDUCTED BY	REVIEWED BY

Gore & Storrie Limited TEST NO. 4

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
20 Sep/87	MOE - Water Plant Optimization Study Peterborough WTP	380.71

TEST DESCRIPTION

Removal of Colour and Turbidity with Alum or Polyaluminum Chloride.
Aluminum Residuals Checked, 1 Litre Jar Tests, Raw Water #1.

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	(1) WATER QUALITY AFTER TREATMENT					
	(2) Alum	(3) PACl		pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	Al (mg/L)
raw									
2	15		4	7.29	0.30	<5	84	104	0.29
3	40		1-2	7.20	0.18	<<5	75	104	0.15
4	50		1-2	7.11	0.17	5	71	104	0.12
5		3	3	7.34	0.16	<5	91	104	0.16
6		5	3	7.34	0.16	<5	90	104	0.21
7		7.5	3	7.31	0.16	<5	88	104	0.25
RAW,UNTREATED				7.59	1.2	5-10	92	110	

SAMPLE TEMPERATURE Start: 11.0°C Finish: 15.0°C

COMMENTS

(1) Treatment Steps: Alum or Polyaluminum Chloride added; stirred at greater than 100 rpm for 2 minutes, 30 rpm for 30 minutes; settled for 30 minutes and filtered through a 1.2 µm membrane filter by vacuum filtration.

(2) Commercial grade equivalent $Al_2 (SO_4)_3 \cdot 14H_2$ added from a 10 mg/mL solution.

(3) Sternson polyaluminum chloride added from a 10 mg/L solution.

Floc Rating:		
	1 - very good	4 - very poor
	2 - good	5 - no floc
	3 - poor	

CONDUCTED BY	REVIEWED BY

Gore & Storrie Limited TEST NO. 5

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
23 Sep/87	MOE Water Plant Optimization Study Peterborough Water Treatment Plant	380.71

TEST DESCRIPTION

Removal of Turbidity and Colour with Alum
Aluminum Residuals Tested - 1 Litre Jar Tests, Raw Water #2

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	(1) WATER QUALITY AFTER TREATMENT					
	(2) Alum	(3) PACl		pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	Al (mg/L)
raw									
2	15		2	7.48	0.18	<5	65	104	0.10
3	25		1-2	7.39	0.14	<5	64	104	0.09
4	30		1-2	7.32	0.15	<5	62	106	0.08
5		3	3-4	7.65	0.18	<5	71	104	0.10
6		5	3	7.64	0.15	<5	71	104	0.11
7		7.5	2-3	7.65	0.14	<5	71	104	0.13
RAW, UNTREATED				7.88	0.88	5-10	90	104	

SAMPLE TEMPERATURE Start: 23°C Finish: 23°C

COMMENTS

(1) Treatment Steps: The pH of the raw water was lowered to 7.0 with 0.1N H_2SO_4. Alum or Polyaluminum Chloride was added; stirred at greater than 100 rpm for 2 minutes, 30 rpm for 30 minutes; settled for 30 minutes and filtered through a 1.2 µm membrane filter by vacuum filtration.

(2) Commercial grade equivalent $Al_2(SO_4)_3 \cdot 14H_2O$ added from a 10 mg/mL solution.

(3) Sternson polyaluminum chloride added from a 1 mg/mL solution.

Floc Rating:	
	1 - very good
	2 - good
	3 - poor
	4 - very poor
	5 - no floc

CONDUCTED BY	REVIEWED BY

APPENDIX E

DAILY LOG

RD OF DAILY OPERATIONS

W WATER	WASH WATER - PLANT #1	WASH WATER - PLANT #2
ES	PRES	PRES
EV	PREV	PREV
TAL	TOTAL	TOTAL

NE #1 FLOW	ZONE #2 FLOW	TOTAL FLOW
ES	PRES	PRES
EV	PREV	PREV
TAL	TOTAL	TOTAL

ERIRATE			CHLORINE RATE			CHEMICALS			MISCELANEOUS	
	P#1	P#2		PRE	POST		H_2SiF_6	ALUM	RIVER LEV.	
			0-8			0-8			P.S.I.	
			8-4			8-4			RIVER FLOW	
2			4-12			4-12			H_2O TEMP	
.			AVE.			TOT.			AIR TEMP	

S IN USE (HRS) PLANT #1										#2	
	1	2	3	4	5	6	7	8	9	1	2
2											

BACK WASHES PLANT #1										#2		WEATHER
	1	2	3	4	5	6	7	8	9	1	2	
0-8												
8-4												
4-12												

PUMP HOURS OF OPERATION

OW LIFT					PUMPHOUSE						CLONSILLA					
	1	2	3	4		1	2	3	4	5		1	2	3	4	
					0-8						0-8					
					8-4						8-4					
2					4-12						4-12					
					TOT						TOT					

OPERATOR	
0-8	
8-4	
4-12	

ARKS

TERMS OF REFERENCE

Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

Work Tasks

1. Receive an information package from the MOE. Review the information provided and meet with the MOE staff, if required, to discuss the project.
2. Document the quality and quantity of raw and treated waters.
3. Define the present treatment processes and operating procedures. Prepare a progress report on Works Tasks 1-3 for the Project Committee.
4. Assess the methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant.
5. Assess current disinfection practices and possible improvement methods.
6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal.
7. Prepare a draft report for the project committee's review.
8. Prepare the final report.

06/04/87 (REV. 1)

1. RECEIVE AN INFORMATION PACKAGE FROM THE MOE. REVIEW THE INFORMATION PROVIDED AND MEET WITH THE MOE STAFF, IF REQUIRED, TO DISCUSS THE PROJECT.

Elements of Work

(a) Receive an information package from the MOE concerning the plant and the study. This package includes a general terms of reference, a general table of contents for organizing the study in a manner consistent with other plant reports, the WPOS reporting tables and a copy of Ontario Drinking Water Objectives.

(b) Review the information and prepare for a meeting to initiate the work on the project, including preparation of a schedule of manpower and staff committments.

(c) Meet with the MOE to discuss the available data, the terms of reference, and the project staff and work schedule. If a consultant is carrying out more that one study it may not be necessary to meet with the MOE at the start of each study.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS.

Elements of Work

(a) Prepare a monthly summary of maximum, minimum, and average flows for the last three consecutive years (Table 1.0). Address any discrepancies which exist between raw and treated flow rates.

(b) Based on the above, briefly review and tabulate for the last three years, the monthly maximum, minimum, and average per capita flow for the total population served by the plant (Table 1.1). Compare the plant data with typical per capita flows for the local region. Indicate major consumers who may influence the figures.

(c) Document the methods of measuring the raw and treated water flow rates.

(d) Summarize, for the last three consecutive years, where available, the raw and treated water; turbidity, colour, residual aluminum/iron, pH, temperature and treatment chemical dosages (other than disinfection and fluoridation). The summary should indicate the monthly daily average and maximum and minimum day (Table 2.0).

For the same three year period, tabulate also the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with particulate removal occurred (Tables 2). Document enough data to define and evaluate those problems.

Record other data, such as particulate counting, suspended solids, and algae counting (Table 5.0) which could reflect on particulate removal efficiency.

Document the source and methods used in determining all information.

A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(e) Summarize for the last three consecutive years, where available, the disinfectant demand, dosages (including all disinfection related chemicals and residuals) for all application points as well as fluoridation dosage and residual. The summary should indicate the monthly daily average and maximum and minimum day (Table 3.0).

For the same three year period, tabulate (Table 3) the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with chlorine residuals and/or positive bacterial tests identified in Table 6. Document enough data to define and evaluate those problems.

Document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(f) Prepare a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information (Table 4). Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information.

Document the source and methods used in determining all water quality information and establish the validity of the data, comparing plant and outside laboratory data.

(g) Tabulate, for the last three consecutive years, the raw and treated water bacterial test information at the plant (Table 6).

Document the source and methods used for all data provided.

(h) Document the water sampling systems (source, pump, line-material and size, vertical rise velocity sampling location) used in the plant (similar to DWSP Questionnaire in Appendix A).

(i) Prepare a summary of inplant testing including Test, Sampling Point, Testing Frequency, Reporting Frequency, Testing Instrumentation including calibration.

(j) Identify other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. PREPARE A PROGRESS REPORT ON WORK TASKS 1-3 (8 COPIES), FOR THE PROJECT COMMITTEE.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings of a reduced size, to document the general site layout and the interrelationship of major plant components. If available, include a process and piping diagram (PAPD) of the plant operations.

(b) Prepare a simplified block schematic of all major plant components including chemical systems and indicating design parameters. **Appendix B is an example of the required standard schematic.**

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems. The record should include approximately 30-40 coloured (9 cm x 12 cm) (or 10 cm x 15 cm) prints, suitably labelled. The progress and draft reports may include photocopies in lieu of the prints.

(d) Tabulate the design parameters for all the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the DWSP Questionnaire (Appendix A) and must be confirmed and verified by field observations. The design parameters should be evaluated at design, rated and actual operational flows.

(e) Prepare a summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document all reported and other apparent problems in plant operations and/or in the distribution system related to water quality. In addition list the health related parameters which exceed the Ontario Drinking Water Objectives (Table 7).

(g) Submit 8 copies of the progress report to the Prime Consultant for distribution to the Project Committee.

4. ASSESS THE METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT.

Elements of Work

(a) Assess the validity and implication of all information relating to particulate removal provided in Work Tasks 1 and 2 with emphasis on method, metering and sampling, etc.

(b) Using information provided in Work Tasks 1, 2 and 3 evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be 1.0 F.t.u. It should, however, be recognized that it is desirable to strive for an operational level which is as low as is achievable.

(c) Conduct an evaluation of possible optimum performance alternatives. Include jar testing using established industry practice.

(d) Evaluate the feasibility of optimum removal using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(e) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

5. ASSESS CURRENT DISINFECTION PRACTICES AND POSSIBLE IMPROVEMENT METHODS.

Elements of Work

(a) Assess the validity and implication of all information relating to disinfection provided in Work Tasks 1, 2 and 3 with emphasis on method, metering and sampling etc.

(b) Using the information provided in Work Tasks 1, 2 and 3 evaluate the plant's ability to disinfect the water. The basis of minimum disinfection should be to ensure a water quality as described in the Ontario Drinking Water Objectives.

(c) Conduct an evaluation of possible optimum disinfection procedures for the plant, with consideration also given to the reduction of chlorinated by-products in the treated water.

(d) Evaluate the feasibility of the various alternatives using the existing plant capital works.

(e) Assess the relative merits of the alternatives. Describe the operational procedures, management strategies, and equipment required for the feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation for the alternatives.

6. DESCRIBE POSSIBLE SHORT AND LONG-TERM PROCESS MODIFICATIONS TO OBTAIN OPTIMUM DISINFECTION AND CONTAMINANT REMOVAL.

Elements of Work

(a) Prepare a list of modifications which should be considered for detailed implementation evaluation. Provide an estimated cost and possible schedule for implementation for each of the proposed modifications.

It is not the purpose of this study to provide a detailed implementation scheme for plant rehabilitation. It is, however, necessary to scope the feasible short and long-term process modifications required to achieve optimum disinfection and contaminant removals.

(b) Incorporate (a) above in the draft report.

7. PREPARE A DRAFT REPORT FOR THE PROJECT COMMITTEE'S REVIEW. (8 COPIES).

Elements of **Work**

(a) The report must include all information for Work Tasks 1-6.

The information must be organized and presented in a logical and co-ordinated fashion. A general table of contents (Appendix C) is provided for organizing the material in a manner consistent with other plant reports.

Submit the draft report for review by the Project Committee.

(b) **Meet with the Project Committee on site at least one week after submission of the report.**

(c) Prepare a separate letter report containing recommendation(s) concerning the need for additional field testing to cover quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

8. PREPARE THE FINAL REPORT.

Elements of Work

(a) Conduct additional field testing if required. Discuss the implementations of the results with the Project Committee if the results differ from the predicted performance.

(b) Amend the report as per review comments, incorporating additional field data if required.

(c) Submit 25 copies of the final reports (including the colour photographs) to the MOE for distribution.